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Forthcoming Events.

MAY 5-6.

Iron and Steel Institute:—Annual meeting and dinner in London.

MAY 7.

Institute of Marine Engineers:—Visit to the National Physical Laboratory, Teddington.

Institute of British Foundrymen.

APRIL 29.

London Branch (Junior Section):—Annual general meeting in London.

APRIL 30.

Newcastle-upon-Tyne and District Branch (Junior Section):—Annual general meeting, and general discussion.

West Riding of Yorkshire Branch:—Annual general meeting at Bradford.

MAY 7.

Lancashire Branch:—Ordinary meeting at Manchester. "Silicon as an Alloying Element," Paper by J. Arnott, A.I.C.

MAY 12.

London Branch:—Annual general meeting. "Crucible Melting Furnaces," Paper by G. L. Cassidy.

The Budget, the Tariff and the Foundry.

Perusal of the Budget speech soon proved that any hope of constructive and critical comment was vain. Any discussion on the Budget would soon have resolved itself into an argument on the respective merits of tea and beer as beverages. It was about as dull and unimaginative a document as possible, perhaps necessarily so. But after the pill came the sugar coating, for the Tariff Commission has issued schedules of new tariffs which actually came into force on Tuesday of this week. It will be seen that both Schedule I and Schedule II interest the foundry industry. In the case of Schedule I, Group I, the pottery and glass industries get some relief, and their requirements for both furnace and mould castings should grow. Group II covers furniture made wholly or mainly of metal, and specifies bedsteads, hollow-ware, stoves, grates and ranges, tube and pipe fittings, all of which have an extra 10 per cent. added to the existing duty of 10 per cent., making 20 per cent. in all. Of these, probably the pipe fittings are the most important, as the Swiss, French and Belgians have carried on a considerable business hitherto. In this group an exception is made of iron or steel baths, which carry only a 15 per cent. duty. Group III covers manufactured articles made from non-ferrous metals, which carry a 20 per cent. duty. Group IV is primarily of interest to the malleable trade, as it covers locks and keys, bolts, hasps and hinges. Agricultural implements are in the same category and have a 15 per cent. duty, the same figure applying to agricultural machinery in Group VI, which, with certain exceptions, have a total duty of 20 per cent. Group V covers a quantity of electrical goods, including heating and cooking apparatus, and meters, which again is of great concern to the foundry industry. These have to bear a total duty of 20 per cent. Extra duty is scheduled to be carried by textiles, chemicals, soaps, leather and paper goods, all of which employ castings for their manufacture. Group XIV, including cycles (but not motor cycles, which are covered by the McKenna duties), carries a duty of 33⅓ per cent. In the miscellaneous Group XVI, sports goods and toys carry a duty of 25 per cent.

Schedule II applies a total duty of 33⅓ per cent. to the iron and steel trade, for a period of three months only, until more permanent arrangements can be made. In this group enter castings in the rough or machined weighing one hundredweight or over. Machinery coming into the country receives special consideration if it is not procurable domestically, and its importation is desirable for facilitating the establishment of new industries.

This order makes a change of the first magnitude in the fiscal history of this country and will have a profound influence on the foundry trade. Foundry sales managers should commence a vigorous campaign to ascertain its immediate reactions. Any increased consumption of iron and steel will react on the mining industry, which latter is a serious user of castings. The tinplate trade has in recent years been buying German and Belgian castings in the form of annealing-box stands and covers. We have seen these made, both at home and abroad, and received the impression that the domestic producers devote too much time and energy in producing what is, perhaps, a needlessly fine finish. With proper sands, it should not be necessary to "nail" the whole surface, nor to do more than spray-blacklead the mould surface. Ingot moulds, furnace castings and the like should be consumed in larger quantities, whilst roll foundries should also experience increased business.

As castings are inclined to lose their identity when incorporated into machinery, we would call attention to paragraph (*b*), Section I, of the Statutory Rules and Orders, 1932, No. 257, which reads: "Goods which fall within more than one of the classes or descriptions specified in either of the said Schedules shall, for the purpose of the charge of the additional duty, be deemed to be goods of those classes or descriptions to which the highest rate of additional duty for the time being chargeable is applicable." From the reading of this we can imagine several important classes of goods, which could be called "castings in the rough" or "castings machined," which can readily and normally carry a second appellation. We suggest that this particular phase will require the constant care of the foundry employers' federations, if they are to receive their just dues, because all articles, without exception, coming within the category "castings in the rough or machined" can carry, and often do, the name of their industrial applications or that of a machine-part.

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Notes from I.B.F. Branches.

Sheffield.—Following the Paper given before the Sheffield Branch of the Institute on the use of pulverised fuel in the foundry, a visit was arranged to the works of Messrs. Clegg & Howgate, Limited, Bingley, so that members could see pulverising plant operating in conjunction with a melting unit. This visit took place on April 15, and proved most interesting and instructive. The melting unit consists of a Brackelsberg furnace of a nominal capacity of 50 cwts., but actually charges up to 5 tons can be melted, the rate of melting being about 1 ton per hr. The pulverising unit, by British Rema Manufacturing Company, Limited, delivers the powdered coal to a bin of 1 ton capacity situated on the charging stage above the furnace. At the time of the visit white-heart malleable iron was being made, but black-heart malleable and ordinary grey iron are also regularly melted. Graphs were displayed showing that the product was remarkably uniform in analysis. The fuel consumption for an output of 10 tons 15 cwts. was given as 33 cwts. of coal. Mr. Howgate informed the visitors that no difficulties whatever were experienced in working the furnace, and certainly at the time of the visit it seemed to be working quite smoothly without apparent attention. The products of the furnace, comprising largely small articles for the automobile and similar trades, had an excellent appearance. Samples selected at random were hammered and bent in all directions to demonstrate the good qualities of the metal.

At the time of the visit 560 tons of metal had been produced from the furnace during the run. In reply to queries regarding the life of the refractory lining, Mr. Howgate stated that the lining of the outlet end of the furnace had lasted over 400 heats, whilst the lining of the front part, which received the most severe treatment owing both to the intense local heating, and to the mechanical abrasion received during charging, had lasted for 160 heats, and still appeared in very good condition. This lining of the front part of the furnace was of English ganister, supplied by J. Hinkley & Son, and was said to be distinctly superior to the original German lining. The visitors were entertained to tea by Mr. Howgate, and unanimously expressed their admiration for the way in which the plant was working.

Lancashire Junior Section.—At the Manchester College of Technology on April 16 thirteen members of the Section were tested in the examination for the John Wilkinson Memorial Medal. Mr. R. A. Jones was in charge, and was assisted by Mr. S. G. Smith. The competitors were given a Paper in five sections, dealing with iron founding, core making, non-ferrous metal founding, general metallurgy and patternmaking. In each section five questions were asked and three answers were annexed to each section; the competitor was asked to indicate the correct one. In the written part of the examination eight questions were asked and the competitor was asked to attempt two, each answer not to exceed 250 words.

The annual general meeting of the Section was held on April 23 in the Manchester College of Technology. The report of the secretary (Mr. A. Burgess) referred to four visits which had been made to the works of the Clay Cross Company, Limited, Platt Bros., Limited, G. Richards & Company, Limited, and the Manchester Corporation Electricity Station. At the meetings the attendance was not good, the average being 35 with a membership of 85. The results of the competitions in 1931 were: Mr. J. Holmes won the John Wilkinson Medal; Mr. B. Haigh the Institute Buchanan Medal, and Mr. E. Jackson the Short Paper Competition. In 1932 there were five entrants for the Short Paper Competition, and the results were made known a little earlier than usual, so that they could be included in the Report. Mr. B. Haigh gained the first prize, given by Mr. T. Makemson; Mr. Foden secured the second place, and will receive a prize given by Mr. R. A. Jones.

A vote of thanks to the retiring officers was passed unanimously. Mr. T. Makemson remarked that the Section had had a very successful year. The good it did was not to be measured by the number of attendances, but by the quality of the work. Mr. H. V. Grundy, the retiring President, said his twelve months in office had given him a wider outlook on life and he had been well repaid for his trouble. Mr. R. A. Jones was elected President; Mr. N. Cook, Vice-President; Mr. R. Yeoman, treasurer, and Mr. A. Burgess secretary. Mr. A. Key read a Paper upon "The Merits of Oil-Bonded Sands."

The Late Mr. Charles Retallack.

Mr. Charles Retallack, who died suddenly last Friday week at his residence in Sutton Coldfield, had been closely identified with the foundry industry for more than half a century. He was born at Portreath, Cornwall, in 1850, and went

to Birmingham to enter the Cornwall Works of Messrs. Tangyes, Limited.

For a number of years he was a member of the well-known firm of John Harper & Company, Limited, Albion Works, Willenhall, of which he became a managing director on the death of the late Alderman John Harper in 1903, until he retired at the age of eighty. He still remained on the board of directors, and retained his active interest in its development. He had travelled extensively on the Continent and America, and will long be remembered for the keen devotion which he gave to the technical advancement of the foundry industry.

He assisted in the formation of the British Cast Iron Research Association, of which he was a Vice-President. As a member of the Handsworth Urban District Council he strongly supported the extension of the boundaries of Birmingham in 1911.

For many years he was a great admirer of Mr. Joseph Chamberlain, of whose tariff policy he was an enthusiastic advocate. He was President of the Willenhall & District Ironfounders' Association, and a member of the Advisory Committee of the Willenhall Labour Exchange.

Mrs. Retallack died two years ago, and he is survived by two sons, both of whom are associated with the firm of John Harper & Company, Limited.

Random Shots.

"This is the White Metal Season in the fashion world. The day-time jewels, which until recently were decoratively-arranged garlands of gay-coloured beads, are now chiefly metal dog chains and curtain rings. Instead of silver and gold we are bedecking ourselves with the metal used for kitchen taps and bathroom fittings."

* * *

"Marksman" clipped the paragraph from his morning newspaper because it sounded promising. What with high tax and low dividends, and the golden sovereign at 25s. 6d., he saw distinct possibilities in this fashion note. Not that he is one to begrudge the ladies what they set their hearts upon. . . . But fashion that spells economy is novel, and ought to be encouraged, had it not? Of course!

* * *

So to encourage it "Marksman" went prowling around a departmental store, all eyes and ears and sixpences for metal dog-chains and curtain-rings. He found them. Very well made they were too, serviceable and value for money. But considered as day-time jewels . . . "Marksman" felt just a little dubious. So did the young lady saleswoman, as she eyed him as he eyed them. And then he remembered a little dinner that would mean his late arrival home that evening. Imagine it. Returning to the wife in the still small hours with dog-chains and curtain-rings, and proffering them as day-time jewels, with a story of a lost fashion-note. It was impossible. It became quite impossible.

* * *

Epitaphs can—although they shouldn't—be very good fun. You probably all have heard the Irish classic:—

Here lies the body of
John Mound,
Lost at sea
And never found.

One of our literary reviews published a whole selection recently, of which I quote the two that pleased me best. One is on a newspaper magnate:—

His Press o'erflowed thee, earth, with seas of ink.
With tons of paper strewed thy loveliness.
He made the truth impossible to think:
Press, Earth, thy heaviest upon him!
PRESS!

The second is on a plumber:—

His burial
Was long delayed,
For they forgot
To bring a spade.

* * *

The commencement of street-corner schools in Berlin to instruct pedestrians how to avoid being run over is a happy idea. It has always seemed to "Marksman" that a special technique is involved in road-crossing, especially road-crossing in London. The pedestrian has to know just when to go forward and when to turn back. We must, most of us, be born with this technique, because it is hardly to be learnt by experience. The man who goes forward when he should have turned back—well, that generally ends his attempt to master it, or considerably delays it. All sorts of devices have been suggested to enable the safe crossing of roads; our humorous cartoonists being especially rich in ideas. As a really and truly satisfactory solution, two alternatives suggest themselves. One is to abolish all road traffic, the other is to abolish all pedestrians.

* * *

Policeman, to man in evening dress clinging to lamppost: "Now then, what's the matter?"

Man in evening dress: "My wife won't let me in."

Policeman: "There's nobody at home."

Man in evening dress: "Of course there's somebody at home—there's a light upstairs."

Marksman.

Italian Steel Foundry Practice.

By Dr. Ing. Guido Vanzetti.

(*Concluded from page* 249.)

Stricter Specifications.

One of the reasons of the popularity of the electric furnace was precisely that of quality. During the past few years specifications for steel castings have been tightened. This has been a point in favour of electric furnace operations. Then, too, there has been a change from cast iron to steel of many types of small castings, especially for motor-car work. These factors made it more difficult for the open-hearth shops, where it is impossible to obtain the high temperature reached in electric furnaces, and, on the other hand, converter shops with which one cannot produce steel of the purity of the electric steel.

The running of the converter has been defined as "a barbaric operation which causes a veritable emulsion of slag-oxides-dissolved gas, in the steel." All these substances are to be found in more or less considerable proportions in the castings, or in the form of solid inclusions, or blow-holes. And this always happens in spite of the fact of obtaining a great reduction of the disadvantage by allowing the steel obtained from the converter to be killed in the ladle or in a mixer. Benedicks points out that as converter steel is more fluid than other steels it becomes easier to eliminate its impurities. A greater fluidity carries with it a greater "rising velocity." But to this one can reply that, even admitting this greater fluidity of converter steel, electric-furnace steel comes out better logically as it is purer, because the impurities to be eliminated are in a much smaller quantity. On account of the different conditions under which the process of manufacture takes place, seeing the absence of any kind of gaseous matter blown into the furnace, the metal can be killed, readily assuring sound castings. In relation to the converter, the electric furnace offers all the advantages of the open hearth source of heat independent of the internal reactions, therefore wider liberty in conducting operations and option of prolonging the refining period until the attainment of steel of the exact properties required, with the possibility of controlling the analysis at any moment.

The deoxidation of the metal comes about under very satisfactory conditions because it is easy to maintain a non-oxidising atmosphere, and, further, a steel is obtained which contains very little nitrogen and hydrogen. The temperature is easily regulated and is always under exact control, and can reach any degree practically desired. There is the possibility of liquefying very refractory slag. Electric steel, being of a higher quality, can be forged more easily. According to Levasseur electric steel is less susceptible to deformation in quenching.

Electric steel is less injured by overheating than other steels. It has a wider range of heat-treatment and, according to Matthews, will stand variations in forging, following treatment without injury. Considering the chemical properties of the steel, it may be observed that with the acid converter (which is generally used in the foundry because the basic ones do not give a steel hot and fluid enough to pour castings) it is not possible to eliminate sulphur and phosphorus, thus demanding a very pure metal from the cupola. It is thus not possible to utilise all the scrap produced, because, on account of the large melting loss, there arises a concentration of sulphur and phosphorus.

Sulphur and Phosphorus in Bessemer Steel.

Even the method of eliminating phosphorus by treating the steel with lime in a ladle with a basic or neutral lining, immediately after the blowing and before the deoxidation and recarburising additions is not very efficacious, because the quantity of phosphorus which is thus eliminated, is very limited. Further, there is produced a cooling of the bath, and the recarburation with the iron coming from the cupola again increases, although in a smaller proportion, the phosphorus content. In any case it may be understood that the possibility of making additions in the furnace itself, as can be done with the electric process rather than in the ladle, increases the probability of thorough assimilation, diffusion and homogeneity.

As for the sulphur, with the electric furnace there is no contamination by this caused by means of heating, as happens with the cupola and with the open hearth; there is, instead, the means of desulphurising completely.

It has been attempted to reduce the final sulphur in converter steel by introducing less sulphur in the melting of the iron and by eliminating it before transforming the iron into steel. Stoughton studied a method of partial heating of the cupola by oil combustion, decreasing the consumption of coke and the consequent inclusion of sulphur. Or the molten iron coming from the cupola can be treated with soda ash in a neutral-lined ladle, or, better still, in a special forehearth (Scharlibbe system) arranged in such a way that the acid slag does not come into contact with the additions. In this case the desulphurisation could not be brought about because the affinity of the soda for silicon is greater than for the sulphur. With a proportion of alkali corresponding to $\frac{1}{2}$ per cent. of the weight of the iron, there can be obtained a reduction of 50 per cent. in the sulphur content. But, of course, this system is not economic, and offers the disadvantage shown in our foundry of the rapid destruction of the acid lining of the converter in the case where any basic slag might come into contact with the iron.

Foundry Properties of Electric Steel.

The foundry properties of electric steel are by far the most important, but unfortunately it is very difficult to represent them in figures. When in the same foundry, there are utilised steels for castings produced by the electric furnace and by other processes (not taking into consideration the crucible), it can be seen that the first give incomparably fewer cracks, blow-holes, etc. An interesting comparison* has been drawn between the converter and the electric furnace practically obtained by the running at the same time of the two systems in the Taylor-Wharton Iron and Steel Works. The results were in favour of the electric furnace. The rejections resulting from the converter steel on account of cracks were equally present even when the sulphur content was less than in the castings poured with electric steel and turned out perfectly sound.

It is generally recognised that the percentage of rejections of castings with the electric furnace is much lower.

According to Levasseur the heads of castings poured with electric steel can be reduced without disadvantage. It is possible to obtain thin castings or those presenting thick and thin sections more easily than with the other processes.

Life of Electric Steel.

Another important point to be considered is the life of the metal. Although this may have been sufficiently studied with reference to iron, the case is different as regards steel. Further, the comparison of the life of steel obtained by the various processes is very much discussed, but it has not yet been well defined. Often "life" is confused with that of temperature. It is sometimes stated that steel obtained by the basic electric furnace is less fluid than that obtained by the acid process, but personal opinion is that it is more the case that, with an acid furnace, higher temperatures are attainable than with the basic furnace, due to the absence of a heavy slag and to a better resistance to the heat of the acid hearth. On the other hand, there does seem to be a certain difference between the actual fluidity of the two kinds of metal.

I therefore find it rather debatable to assert that steel obtained with the electric furnace is less fluid than that obtained with the converter, as some of the upholders of this latter process sustain. But, actually, the fact that converter castings are more liable to defects than others (mainly the characteristic defects of metals poured too hot—cavities, cracks, oxidation, etc.) shows that the greater life of converter steel is due exclusively to the higher temperature at which it is poured.

With regard to life of the metal, even a direct comparison of the two methods would only be of relative importance unless account were taken of all the different variables which are called into play in the life. I say life, and not fluidity, because whilst the latter indicates an intrinsic quality of the metal, the former varies also with the change of extraneous conditions as regards the metal. Portevin has defined coulabilité or life as being the faculty which molten metals have of filling more or less completely a mould, and it may be said that the life depends on the characteristics of the metal (temperature, chemical composition), of the mould (surface conditions, moisture, temperature, permeability, etc.) and on the manner in which the metal is poured into the mould.

The factor which influences most profoundly the life of steel is the temperature; for reasons already shown with regard to the disadvantages arising from a steel which is too hot, to which is to be added the danger of the fusing of the moulding sand, it is, above all, necessary to try to obtain as low a minimum ratio point as possible of temperature life. With regard to the influence of the composition of the metal on the life, it is ascertained by practice that an oxidised steel is less fluid than a non-oxidised steel.

It is generally recognised that for iron the chemical composition of the metal has an influence on the fluidity. For steel, Mr. Gabino, of the Fiat works, in one of his recent Papers for the last Foundry Congress, states that, as a consequence of various experiences met with in the study of the life of steel, he found no pronounced influence of the chemical composition (within the limits of normal variations) on the life. He only observes a large increase of fluidity of the bath after the addition of ferro-silicon. This fact, which contrasts with the observations of Benedicks, probably arises from the deoxidising action of the ferro-silicon. Mr. Gabino shows in his Paper, too, in what way the condition of the mould influences the life—greater life is given with dry moulds and less with green-sand moulds. In green sand, with 1 per cent. of dextrin, it is, however, possible to obtain nearly the same results as with dry sand.

Finally, there is considerable importance to be attached to the outflow velocity of the metal into the mould—velocity which is created by the height of the ferro-static loading column and the length of drop of the steel jet; conditions of running the steel into the mould as arising from the runner sections; size and shape of the runner bush and the manner in which the metal is poured. We have observed that moulds poured apparently under identical conditions gave us alternately sound castings and short-run castings. This was due to the fact that, pouring with the large bottom-pouring

* "Foundry," February 1, 1920.

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ladle with different openings of the stopper, the runner bush was not continually full. Even the formation of a vortex in a circular feed box makes its influence felt, because the swirling motion produces a load loss. This disadvantage can be avoided by using an oval pouring basin.

From all these points which have been discussed and which have influence upon the life of steel, it can be seen that it is difficult to establish with certainty by which method of manufacture a greater fluidity of metal can be obtained. In fact, it is difficult to render constant all the variables of the problem. And when we come to think that up to a short time ago the optical instruments for the reading of the temperature were liable to errors up to tens of degrees, and that a difference in temperature of such magnitudes has considerable influence upon the viscosity of the metal, it will be understood in what measure the comparisons between the results obtained with the various methods corresponded to a personal statement or opinion rather than to a comparison of figures.

To finish this short comparative study of the various methods of manufacturing steel, it can be concluded that when considering open hearths and converters, each of these present a series of advantages and disadvantages which cause the preference to be given to one process or the other according to the particular case as regards use. As for the electric furnace, it is evident that, when well run, it embodies such industrial advantages, technical or economic, which are of such importance that its superiority becomes beyond discussion except in cases where the price of electrical energy might be too high.

Up to now I have made no mention of electric-induction furnaces and pulverised-coal-fired rotary furnaces. The main reason for this is that I do not know sufficient of the subject to be able to discuss it with authority.

In our own foundry we have thoroughly examined the advantage of using an induction furnace for the manufacture of special steels, but we halted on account of the following considerations:—(1) Extremely high cost of installation and (2) the last word has not yet been said regarding the practical realisation of the principles on which it is based: voltage—number of periods—construction of condensers—construction of acid and, above all, basic lining; (3) difficulty of refining because slag is colder than metal, being a non-conductor. On the other hand, there are certain advantages:—(1) No alteration in the bath on account of the presence of electrodes and air (it being possible to close the furnace—in the laboratories melting is done even *in vacuo*)—and (2) a saving of current.

Starting out with raw material of the best quality, anything can be done that may be required. It may be possible that anybody who has been obliged to purchase one of these furnaces for high quality steel, may be able to use it also for the production of ordinary carbon steel. To-day the study and the production of high tensile cast iron is being extended: the induction furnace can very well serve for the purpose just as for any kind of special steel. Its use is ideal in the case of remelting special steel scrap.

In summing up, we foresee that in the course of time we shall end by deciding on the purchase of one of these furnaces, once the disadvantages explained have been removed or reduced and the consumption of special steels becomes such as to warrant the installation cost.

The Brackelsberg and the Sesci acid-lined rotary furnaces, according to some, have an ensured future in the steel foundries. Whilst in the open hearth, the temperature of the process is limited by the refractoriness of the roof, in this type of furnace, on account of slow rotation, the roof is changing at every moment, and the bricks which, as a roof, at certain moments are at the highest temperature, soon after cool, giving up their heat to the bath, when acting as bottom. Further, for steel, all temperatures practically necessary are reached by preheating the combustion air by means of a heat regenerator. The latest report which I know of with regard to the Brackelsberg rotary furnace used for steel, is that of Bardenheuer, who states that he has attained very good results both as regards economy in running and quality of the metal obtained. It was very good from all points of view—mechanically, chemically and for foundry properties.

The Vanzetti Foundry.

I now wish to give you a brief idea of the system of steel manufacture used in our Milan foundry. It was established in 1888 for the object of producing light steel castings with the small Robert converter, and the foundry worked for several years with no other apparatus. About 1895, when the increased number of orders made continuous working possible, two small open-hearth furnaces of 3 and 4 tons respectively were installed, and later a third one of 7 tons. In 1910 electric furnaces were introduced—at first three Stassano furnaces of 1 ton each; afterwards two Electro Metals furnaces of 3 tons were built. During the war several more electric furnaces of our own type were installed. At present the steel foundry has two converters, 2 open-hearths, five electric furnaces, but is mostly served by one or two electric furnaces at a time during this period of depression. Already in 1894 we began the production of large castings, using the converter alone. At the Milan works, two Robert converters of about one ton each were installed with two cupolas each capable of melting six tons of iron per hour. There is one piston blowing-engine, driven by electricity, capable of delivering 90 cub. metres of air per min. at a pressure of 40 c. of mercury.

In the early years of the operation of the plant, castings of about two tons maximum were produced, working with one converter only. In 1894 it was believed we could accept the order for the two supporting brackets for the screws of H.M.S. Marco Polo. Each casting weighed 6 tons net, or about 10 tons gross. To avoid the chance of short-running in making the first one, it was calculated that 12 tons of molten metal would be necessary.

At that time the foundry did not possess a travelling crane of more than 6 tons capacity, so that it was necessary to devise a mixer mounted on two standards into which to pour the steel. The casting of the first bracket was a complete success, insomuch that, for the second, it was decided to prepare only 8 tons of steel. The additional 2 tons necessary for the feeding-head were blown afterwards and poured direct into the runner forming the feeding-head. The two cupolas were kept in continuous operation, and the two converters were worked alternately, the blowing engine having to run continuously.

The result was so satisfactory that the firm did not then hesitate to accept orders for much larger castings. Most of the stems, stern frames and rudder frames of Italian merchant and warships were cast by the method described. On account of its convenience, the system in general has been retained to the present day.

Some brief notes on the present method of procedure may be given here.

The Robert foundry consists of three bays, each 10 metres wide. At the end of the central bay are placed the two cupolas. A ladle for receiving the molten metal is run between the two cupolas, and when filled is lifted by a special windlass to a height sufficient to enable it to tip the metal into either one or two sheet-iron troughs which can be slewed on a swivel. Through these troughs it flows into the converters. These latter are tilted by motors, but hand gear is also provided. A travelling crane ranging the whole length of the bay brings the steel ladle into position to receive the charge from the converters, and pour it into the mixers, which are suitably placed in the foundry for pouring the contents direct into the mould.

It will be understood that it is necessary to have the metal very hot and to work very rapidly, other considerations of economy having to be sacrificed to these two conditions. On this account, a higher proportion of pig than of steel scrap must be charged into the cupola, the quantity of coke for melting is increased, and moreover the converters are furnished with eight instead of five tuyeres. A higher air pressure is thus required for blowing the converters, and this increases the loss in blowing.

It was customary to send the first heats from each converter to the foundry for ordinary castings, then, when a sufficiently high temperature was reached, the filling of the mixer was begun.

We have noticed that the chemical composition and mechanical properties of steel have improved after remaining a long time in the mixer. The steel as it comes from the converters contains considerable quantities of oxides and slag in suspension. During the time it remains in the mixer these impurities separate partly by liquation and partly by the reactions produced by the manganese and silicon content in the steel. It is precisely on account of these reactions that it is possible to keep the bath hot into the mixer for several hours.

The converter, providing a means for obtaining at short intervals a very hot steel in small and frequent quantities for feeding the head, reduces very considerably the volume and weight which it is necessary to give to the feeding-head.

We have been successful, with this system, in pouring castings up to 30 tons using two mixers, and up to 50 tons using also the steel coming from the other furnaces which was poured together with that of the mixers. Recently we had to pour a certain number of castings of 30 tons, and we found it more economical to use the first heats of the converter, still rather cool, for charging the electric furnaces instead of for pouring castings. The electric furnaces ran contemporaneously with the converter. Our charges into the cupola are 50 per cent. hematite iron and 50 per cent. steel scrap, the scrap consisting principally of springs with 1.5 per cent. of silicon.

The two open-hearths are in good working order, but for several years they have not been running. They are being held in reserve awaiting better times, which makes our position secure in case of any subsequent exceptional increases of cost of electrical energy.

Electric Furnace Plant.

Further, we possess three electric arc furnaces, Electro Metals type, basic lined, of 3 tons each, with automatic regulation (Brown Boveri). The main advantage of this kind of electro-hydraulic regulator consists of its great sensitivity and the fact that the electrodes drop only by their own weight, and this avoids all risk of breakage. The electrical energy, which is supplied to us in three-phase form at a tension of 22,500 volts, is transformed with a Scott connection by means of two monophase transformers.

In normal working, the two electrodes are equally loaded, and with the Scott system of primary connections, equal loading of the three primary phases is assured. This is a most important feature, and is much appreciated by power station engineers. Metallurgically, the two-phase furnace offers the greatest possible advantages. The magnetic field set up by the combination of the two arcs and the conducting hearth imparts a circulation to the molten charge, partly in a horizontal and partly in a vertical plane. This results in bringing all portions of the liquid charge into successive contact with the highly-heated refining slag, and by dissipating the heat from directly under the arcs reduces radiation on to the roof and walls.

Further, this equalisation of temperature between the upper and lower portions of the

charge facilitates the melting of alloy additions used for special steel manufacture. Some of these alloys, such as Fe-V, Fe-W and Ni, are very much denser than steel, and have high melting points. Consequently, when they are thrown into the steel, they at once sink and lie on the bottom of the furnace. The circulation of the charge in the two-phase furnace brings the pieces of alloy constantly in contact with fresh hot metal from the surface, so that they become rapidly melted and evenly disseminated throughout the charge.

Another noticeable metallurgical feature is the regularity with which the final amount of carbon in the steel can be controlled. This is mainly due to the fact that the two arcs are absolutely independent of one another, so that there is no possibility of one electrode dipping into the metal, and so adding carbon to the charge.

The capacity of the furnaces is 1,000 k.v.a. (two transformers of 500). The secondary windings can be varied to give 90, 100, 110 volts by means of a regulating switch (commutator) placed on the regulation switchboard of the furnaces. The regulation permits, according to the operations which are being carried out, a variation of the power absorbed by the furnace of between 500 and 1,000 kw.

The average consumption of electrical energy for the production of ordinary steel, perfectly dephosphorised, fluctuates between 800 and 850 kw.-hr. per ton of scrap charged. The consumption of graphite electrodes (Plania Werke Siemens) is 3.8 to 4 kg. per ton charged. The time employed for each heat is from 3 to 3¼ hrs., excluding the charging operations and any serious repairs.

When the scrap purchased on the market is so low in phosphorus and sulphur as to be able to avoid the period of dephosphorisation with consequent slagging off, the operation consists of a simple melting of the material under a reducing slag, and in this way we succeed in obtaining very good steel in 2 hrs. (exclusive of the time required for charging and any serious repairs).

We recently installed, essentially for the purpose of producing special steel and in order to be able to utilise our own ordinary carbon steel scrap, two Brown-Boveri electric arc furnaces of 1,200 kg. each. These furnaces have not yet begun working, therefore I cannot tell you much about their characteristics. They are served by a single transformer of 600 k.v.a. (transformation ratio 22,500 to 160), so that they can only run one at the time. (In the transformer it is possible to have commutation from the star to the delta connection and *vice versa* on the primary, so that the following secondary voltages can be procured: 58, 79, 81, 92, 100, 120, 140, 160.) The variety of voltages available permits of running with acid or basic lining. Each furnace is supplied with a spare shell, so that in case of repairs the shell can be rapidly substituted complete with lining and roof. There is also provision for the possibility of adopting a lining which would reduce the capacity of the furnace to 700 kg. There are three electrodes, whilst the bottom is a non-conductor. The regulation is automatic and of the Brown-Boveri electro-hydraulic type. The guaranteed maximum of consumption with basic lining is from 700 to 750 kw.-hr. per ton charged.

Up to the present we have been pouring our castings up to 3 tons with a 3-ton bottom ladle. The main defects of this system are (1) excessively long duration of the pouring, which implicates a considerable difference in temperature of the metal between the beginning and the end; (2) the stopper will not always stand a very large number of openings and closings to which it is subjected when small castings have to be poured, and (3) the height of the ferrostatic loading column is such as to cause the steel to arrive with a considerable energy, giving rise to erosion in the mould and carrying away with it some sand, traces of which are afterwards found in the castings. We have succeeded in overcoming this difficulty by suspending under the ladle hole a tun-dish lined with magnesite. This tun-dish can be emptied by a workman by turning it like a small hand-ladle on a horizontal axle. The steel jet is broken against the bottom of it and falls into the mould.

We certainly think that the best method in which to eliminate all the difficulties mentioned above is to adopt a system of rapid distribution of the steel with small hand-ladles carried by a monorail and fed by the large bottom-pouring ladle. Unfortunately, however, present conditions do not allow us to carry out these transformations and others which assuredly would bring about a reduction in labour.

We are somewhat in the position of a certain person who, when approached by an inventor who offered him a very complicated machine capable of substituting twenty workmen, replied: "Could you not invent for me a machine which would be capable of bringing in twenty customers?"

The following authorities have been drawn upon in the compilation of this Paper:—

B. Osann ("Lehrbuch der Eisen und Stahlgiesserei"); C. Clausel de Coussergnes ("L'Electrosiderurgie"); A. Ledebuc ("Handbuch der Eisenhüttenkunde"); C. Benedicks and H. Löfquist ("Non-metallic Inclusions in Iron and Steel"); G. Geiger ("Handbuch der Eisen und Stahlgiesserei"); W. Lister ("Practical Steelmaking"); L. Barton ("Refining Metals Electrically"); A. Levasseur ("L'Electrochimie et l'Electrométallurgie"); F. T. Sisco St. Kriz ("Elektrostahlverfahren"); D. Carnegie et S. C. Gladwyn ("L'Acier, Sa Fabrication, Son Prix de Revient"); R. Lemoine ("La Production de l'Acier de Moulage"); C. Vanzetti ("The Use of Small Converter for the Production of Large Steel Castings"); J. W. Deschamps ("Considérations sur les Avantages et Désavantages Respectifs des Différents Procédés employés dans la Production de l'Acier en Fonderie d'Acier"); U. Gabino ("La Colabilità dell' Acciaio"); Annuario dell' Industria Metallurgica Italiana, 1930 (Associazione Nazionale Fascista fra gli Industriali Metallurgici Italiani): P. Bardenheuer ("Das Schmelsen von Stahl auf Sauerem Futter im Brackelsberg-Ofen"); B. Osann ("Lehrbuch der Eisenhüttenkunde").

Exchange Restrictions Abroad.

F.B.I. AND CLEARING HOUSE ARRANGEMENTS.

The Federation of British Industries has addressed a letter to the Board of Trade calling the attention of the Government to the severe handicap which is being placed upon industry by exchange restrictions in various foreign countries, more particularly in Hungary and Austria.

The Federation stated in its letter that, although it has hitherto been reluctant to press strongly for the negotiation and institution of clearing-house arrangements, owing to the objections and inconveniences attached to such procedure, it now feels that the establishment of clearing-house arrangements with Hungary and Austria is the only possible solution. The following reasons are given for the desirability of this step being taken:—In the first place, the number of such agreements which have already been negotiated by other countries has very greatly increased. In the second place, whereas the earlier of these arrangements were understood to be working unsatisfactorily, the Federation has received trustworthy information that the later arrangements are working extremely smoothly, in particular as between Hungary and Austria. Thirdly, during the period in which apprehension was still being felt abroad as to the position of the £, the Federation was reluctant to press a course which would have involved legislation for the impounding of balances due to any countries, from a fear of creating the impression that by such legislation it was the intention of the Government to extend this method to other foreign balances held here, thus possibly causing a flight from the £. This fear the Federation feels need happily be no longer entertained.

The Federation added that it continues to hold its previous views as to the undesirability of clearing-house arrangements in general.

Survey of the Position.

An indication is given below of the extent to which prompt payment of current trade debts is prevented by exchange control in foreign countries. The information is taken from a survey issued by the Department of Overseas Trade.

Austria.—Stringent control; great difficulty is experienced in obtaining exchange from the control authorities. The official rate in force in Austria differs widely from the rate quoted in the United Kingdom.

Bulgaria.—Exchange is released only after three months from arrival of goods. Prior sanction of the National Bank is required before foreign bills can be accepted.

Chile.—Great difficulty has been met in securing payment and a system of small monthly allotments has been in operation. The rate of exchange is expected to rise and difficulty in securing payment will continue.

Czecho-Slovakia.—Import of certain goods is allowed only after authorisation for payment has been obtained from the National Bank; otherwise no difficulty is known to exist in securing payment.

Denmark.—Import is allowed only on permit from National Bank. Some seasonal pressure on exchange has been experienced, but apart from luxury goods, difficulty need not, it is hoped, be anticipated.

Estonia.—Strict control; considerable difficulty has been experienced in obtaining exchange.

Germany.—In general, while little difficulty has apparently been experienced in procuring remittances where regulations are observed, apart from occasional delay, less exchange now appears to be available.

Greece.—The Bank of Greece has warned importers to obtain authority for placing orders, as otherwise exchange applications may be rejected. No exchange has been issued by the Bank of Greece since February, except for essential raw material and foodstuffs.

Hungary.—Strict control. Great difficulty is experienced in securing exchange from control authorities. A wide gap exists between the local official rate and that quoted in the United Kingdom.

Italy.—Although control is exercised by the banks, little difficulty is found in obtaining payment for genuine transactions.

Latvia.—Considerable difficulty is encountered in obtaining exchange for payment of imported goods.

Lithuania.—While registration of foreign payments has to be made, there is no actual control over remittances.

Norway.—Importers have been warned by the banks that if the approval of the bank has not been obtained, exchange may not be available. Little or no difficulty has so far apparently been experienced.

Uruguay.—Not much difficulty appears to be experienced in securing payment of current trade debts, although old debts are not being liquidated.

Yugoslavia.—Exchange dealings are controlled by the National Bank and foreign exchange may be sold by authorised banks only for goods already imported. Successive measures have tightened the control.

Catalogue Received.

Chaplets.—A novel type of chaplet (patent No. 306,195) is described and illustrated in a four-page pamphlet issued by the Bolivar Stamping Company, Limited, of Hard Ings, Lane, Keighley. The chaplet is centrally reinforced, which, whilst adding strength, exposes more surfaces for fusing with the metal. Moreover, it is perforated to allow it to be sprigged to the wall of a core or mould. The designers have taken into consideration all such questions as fusibility strength, rigidity, balance and price. The pamphlet offers to supply free samples on request.

The Board of Trade announces that an Order-in-Council was made on April 9 requiring imported iron or steel flush pipes to bear an indication of origin on sale or exposure for sale in the United Kingdom. This Order will come into force on July 9, 1932.

XUM

The New Import Duties.

HEAVY DUTY ON SEMI-FINISHED STEEL.

The Import Duties Advisory Committee have made their first recommendations to the Government regarding further import duties, in addition to the general 10 per cent. tariff which is already in operation, and an Order [Additional Import Duties (No. 1) Order, 1932] has been issued.

The Committee's general scheme is the imposition of a uniform rate of additional duty on fully manufactured goods, with a lower rate for some products where special considerations arise and higher rates for commodities of a luxury or semi-luxury character. They recognise that this may not fully meet the needs of some industries, but are of opinion that this risk must be taken if the general scheme of the Import Duties Act is to be inaugurated with reasonable caution and without over-burdening the Customs administration. As to the general level of protection, the Committee do not regard the Abnormal Importations duties of 50 per cent. *ad valorem* (which were intended to be practically prohibitive for a limited period) as an appropriate precedent; and as regards the Safeguarding and other duties of 33⅓ per cent. it is pointed out that these were applied to selected commodities in exceptional circumstances and cover only a very small part of the industrial field, and that it is impossible to generalise from them as to the effect of a rate of duty of that magnitude applied to a much larger section of industry.

Taking these and other factors into consideration, the Committee recommend for most manufactured goods an additional duty of 10 per cent., making 20 per cent. in all; for a limited number of others, for which a lower rate seems appropriate, a total duty of 15 per cent.; and for certain articles of a luxury or semi-luxury character, total duties of 25 or 30 per cent.

The 20 per cent. category includes certain metal furniture and a number of iron and steel products, the more finished kinds of non-ferrous metal manufactures, cutlery, machinery and tools (other than agricultural machinery and tools), and electrical goods. The 15 per cent. category includes agricultural machinery and tools, a considerable range of building materials (*e.g.*, metal doors and window frames, baths, etc.), and machinery belting. In a few cases the Committee recommend a higher rate of duty, making 33⅓ per cent. in all, mainly in order to bring them into harmony with existing duties on similar products. As already stated, the Committee have recommended a general additional duty of 10 per cent., making 20 per cent. in all, on all machinery. They appreciate, however, that there are some very highly specialised kinds of machinery which are not at present obtainable in this country, and they recommend the making of arrangements whereby, in appropriate cases, such machinery may be admitted free of duty.

Regarding iron and steel, the Committee point out that this presents peculiar difficulties, partly because iron and steel enter as material into so many other industries, and partly because the most intense competition is being experienced in respect of semi-finished goods. The question of the precise tariff treatment of the industry requires detailed examination, but in the meantime the Committee are convinced, first, that the maintenance of a prosperous iron and steel industry in a high degree of efficiency is essential to our economic progress and national security, and, secondly, that abnormal importations at very low prices have been, and are, taking place, and that stocks in this country are substantial. In these circumstances the Committee recommend an additional duty of 23⅓ per cent., making 33⅓ per cent. in all, for a minimum period of three months, on semi-finished steel, in order to check importations until they are in a position to submit a scheme of a more permanent nature. (Semi-finished material is given a very wide interpretation by the Committee, as will be evident from the appended duties.)

Finally, the Committee emphasise that their first recommendations are necessarily general in character. They indicate their readiness to consider as rapidly as possible all representations made to them, and to recommend such adjustments as may be shown to be expedient. In general, however, in order that the industries concerned may have at least a minimum of certainty, they do not propose, save in exceptional cases, to recommend changes in a downward direction for a period of twelve months; but, on the other hand, they make it clear that they are ready to propose higher duties in appropriate cases. In this connection, however, the Committee point out that "in some cases the re-establishment of an industry on a satisfactory basis may be dependent quite as much on its proper re-organisation and re-equipment as on the degree of protection to be afforded."

The duties imposed by the Orders made by the Board of Trade under the Abnormal Importations Act will be terminated simultaneously with the imposition of the new duties recommended by the Advisory Committee. The new duties come into operation as from midnight, Monday, April 25, 1932.

We append particulars of iron and steel, engineering and other products, giving the full rate of duty in each case:—

The following products will be subject to an *ad valorem* duty of 33⅓ per cent.:—

(1) Spiegeleisen and ferro-manganese.

(2) Iron and steel (other than pig-iron, but including alloy steel) of the following descriptions:

(i) Ingots (other than those manufactured entirely from pig-iron smelted with charcoal).
(ii) Blooms, billets, slabs (other than wrought iron produced by puddling with charcoal from pig-iron smelted wholly with charcoal).
(iii) Sheet and tinplate bars.
(iv) Bars, rods, angles, shapes and sections of all kinds, whether fabricated or not.
(v) Forgings (including drop forgings), in the rough or machined.
(vi) Castings, in the rough or machined, weighing one hundredweight or over.
(vii) Horse shoes.
(viii) Girders, beams, joists and pillars, whether fabricated or not.
(ix) Hoop and strip of all kinds.
(x) Plates and sheets of all kinds.

The above comprise Schedule II of the Order, and it is provided that the items specified shall cease to bear the additional duty after the expiration of three months from the date on which the Order comes into operation. In the absence of a further Order, therefore, the duty on these products would revert to 10 per cent. The three months' limitation does not apply to any of the products following.

The following iron and steel products will be subject to an *ad valorem* duty of 20 per cent.:—

(i) Tubes, pipes and pipe and tube fittings of all kinds.
(ii) Railway and tramway construction material of all kinds.
(iii) Springs and spring steel.
(iv) Wire, wire netting, wire nails, and cable and rope (except insulated telephone and telegraph cables).
(v) Screws, nails, tacks, studs and spikes.
(vi) Rivets and washers.
(vii) Bolts and nuts.
(viii) Anchors and grapnels and parts thereof, chains and ships' cables.

Hollow-ware (other than baths) of iron or steel (including tinned plate) will be subject to a duty of 20 per cent.; baths of iron or steel, 15 per cent.; metal door and window frames and casements, 15 per cent.; stoves, grates and ranges for domestic cooking or heating, and parts and fittings therefor, 20 per cent. Articles manufactured wholly or partly of aluminium, copper, lead, nickel, tin, zinc and alloys including any of these metals, and parts of such articles (but not including sheets and strip, rods, plates, ingots, bars, slabs and discs, angles, shapes and sections, wire and tubes; machinery, tools, implements, scientific and medical instruments and apparatus, and parts thereof; and compounds of these metals other than those which are intermetallic compounds) are subject to a duty of 20 per cent.

Furniture made wholly or mainly of metal also carries a duty of 20 per cent.

Cutlery will be subject to a duty of 20 per cent.; locks, padlocks, keys, bolts, latches, hasps and hinges of metal, 20 per cent.; forks, shovels, spades, scythes, sickles and agricultural implements, and parts thereof, 15 per cent.; other tools and parts thereof, 20 per cent. Electric wires and cables, insulated; electric carbons; electric lighting appliances and fittings; batteries and accumulators; electric bell apparatus, are included in the list of products subject to a duty of 20 per cent. Other duties are:

Ploughs, planters and seeders, reapers and binders, sheep shearers and clipping machines, threshers, agricultural tractors and other agricultural machinery, and parts thereof, 15 per cent.

All other machinery and parts thereof (other than ball bearings, roller bearings, and parts thereof, and machinery belting), 20 per cent.

Ball bearings, roller bearings, and parts thereof, 33⅓ per cent.

Machinery belting (including conveyor and elevator bands), 15 per cent.

The following chemicals and other products are included among those to be subject to a duty of 20 per cent.: Nitric acid; aluminium oxide (hydrated or anhydrous), but not including abrasives; ammonia liquor; sulphate of ammonia; nitrate of ammonia; sodium nitrate; sodium nitrite; calcium chloride; tin oxide; zinc oxide.

World's Output of Steel Ingots and Castings.

The subjoined table shows (in tons of 2,240 lbs.) the world's output of steel ingots and castings in 1929 and 1930. The table is reproduced from a Statistical Summary issued by the Imperial Institute.

Producing country.	1929.	1930.
	Tons.	Tons.
British Empire.		
United Kingdom	9,636,200	7,325,700
Union of South Africa† ..	38,269	38,956
Canada	1,378,024	1,011,743
India	575,310	618,922
Australia	*	*
Total	12,000,000	9,400,000
Foreign Countries.		
Austria	621,952	461,000
Belgium	4,044,596	3,336,056
Czecho-Slovakia	2,158,759	1,788,509
France—		
Saar	2,174,022	1,904,237
Other districts	9,545,765	9,297,366
Germany	15,769,785	11,356,346
Hungary	505,362	363,584
Italy	2,088,677	1,715,817
Luxemburg	2,659,579	2,234,060
Norway	3,800	3,122
Poland	1,354,970	1,217,952
Russia‡	4,647,900	5,650,000
Spain	987,611	848,966
Sweden	682,959	601,157
Mexico	110,777	111,929
United States	56,433,473	40,699,483
Japan	2,306,058	2,203,914
China (estimated)	30,000	30,000
Total	106,100,000	83,800,000
World's total	118,100,000	93,200,000

* Information not available.
† Including rails, fishplates, etc.
‡ Years ended September 30.

Progress at the Pretoria Steelworks.—According to the "South African Engineer," rapid progress is being made with construction work of the South African Iron & Steel Industrial Corporation's plant. The main feature is the blast furnace, the construction of which is in an advanced state. The mixer and steel furnaces in the melting shop are under construction, and some of the large girders for this building are in position. These girders will carry the tracks for three 10-ton cranes for handling the molten pig-iron and refined steel. Foundations for other portions of the plant are in many cases nearly complete, and the next few months will see a further big advance in construction work.

Dry-Sand *versus* Green-Sand Moulding.

At a meeting of the Scottish Branch of the Institute of British Foundrymen, held in the Royal Technical College, Glasgow, recently, Mr. Frank Hudson opened a discussion on green-sand and dry-sand moulding. Mr. N. McManus, M.B.E. (Branch-President) presided.

Experience is Guiding Factor.

In the course of his remarks Mr. Hudson said that some weeks ago the members had the privilege of listening to a Paper by Mr. Henry Gardner on "An Engineer's View of the Foundry."* The resulting discussion principally hinged on green-sand *versus* dry-sand castings, and in answer to Mr. Gardner's query as to what constituted the dividing line to be adopted in deciding which class of moulding to employ in the founding of grey-iron castings, it was agreed that there were no hard-and-fast rules available, and the decision should be left to the practical experience of the foundry manager or foreman. This was as it should be, but personally he had one fault to find with that decision, in that each executive probably had had different experiences and varying problems to solve and accordingly individual ideas as to what was considered safe practice would not agree. An exchange of views upon this matter could not be other than helpful, and he had great pleasure in introducing the subject for open discussion.

Rate of Cooling as a Fundamental.

All foundrymen had heard of pearlitic cast iron, and, excluding alloy additions, such material was usually associated with the best mechanical tests and soundest castings, together with satisfactory wearing properties. It was easily machined, having a hardness of approximately 210 Brinell in all sections. The use of dry-sand moulds was standard to the process. Personally he had long thought that every progressive foundry should aim to produce this structure in grey-iron castings, and recently Prof. Osann, the well-known German metallurgist, had drawn up statistics showing the relationship between the various elements in cast iron and the production of this pearlitic structure in the final castings. By the use of his figures it was possible to give the necessary analyses for various sectioned castings to obtain the pearlitic structure without the use of hot moulds. In this way it differed from the Lanz method. As previously mentioned, however, Prof. Osann's calculations were based upon the use of dry-sand moulds, and the point arose as to whether the calculations could be equally applied to castings made in green sand. The question to be solved was: Which type of mould cools the casting the more quickly, green sand or dry sand? Naturally one would say green sand. He felt confident that every foundryman held this view.

Experimental Evidence.

Extending the question further, how much faster did a green-sand mould cool a casting than dry sand, assuming that the metal section and temperature of mould are the same in each case? During the past few days he had asked numerous foundrymen, and they could not tell. He had searched all the numerous Papers given to the Institute, all text-books on the subject, and still the question remained unanswered. He sometimes thought founders spent too much time and thought in thinking of the amazing scientific developments of to-day and how they can apply them to their business, and were rather apt to overlook the simple things and accept a superficial explanation which hid the truth. In the end it was felt that existing knowledge could not supply a true answer to the question, so it was decided to conduct tests in order actually to determine the relative cooling rate of green- and dry-sand moulds. Accordingly a series of green- and dry-sand moulds were made, to form simple castings, rectangular in shape, each casting being of a certain thickness. The usual precautions were taken to ensure comparative conditions, for example the casting temperature was constant, the composition of the iron was the same, mould temperatures were alike. The only variables were section of casting and type of mould. By means of a thermo-couple, placed at the centre of each casting, the rate of cooling was obtained. The sections tested were as follow: ¾, 1, 2, 3 and 4 in. Without exposing a mass of figures he gave the result of the experiment and the conclusions reached. It was found that the cooling rate exerted by dry- and green-sand moulds for castings up to 2 in. thick was the same. In castings above this section the green-sand mould gave slightly faster cooling, the difference becoming more pronounced as the metal section increased. In a 3-in. thick section, the dry-sand mould was 16 per cent. slower in cooling than the green-sand mould, and this increased to 19 per cent. for a 4-in. thick section.

Two-inch Section is Critical Point.

Accordingly, the answer to the question, which type of mould cooled the castings more quickly, green sand or dry sand? could be supplied by the statement that there was no difference in cooling rate between green- and dry-sand moulds on castings not exceeding 2 in. in section, providing other conditions were equal. For castings above this section the green-sand mould promoted more rapid cooling, this becoming more pronounced as the metal section increases.

These tests were latterly extended in order to see the effect of using warm dry-sand moulds, and the effect of the various cooling conditions upon the resulting hardness of the castings, degree of shrinkage, etc., but time was too short for any mention of these. It would appear, however, that the dominant factor affecting hardness was composition. A variation of 0.3 per cent. silicon in the composition of the iron would affect the hardness far more than any difference existing relative to that casting being made in dry- or green-sand moulds.

In view of these results one really wondered how much experience took for granted, and no doubt there were many other points which had an entirely different reaction to considered opinion.

Factors for Consideration.

Some of these other points worthy of discussion between dry-sand *versus* green-sand castings could be outlined as follow:—

(1) What caused the skin of green-sand castings to be harder than dry-sand castings, although the actual metal hardness below the skin was the same? Was it due to chilled metal or to fused sand?

(2) In casting into dry- and green-sand moulds, which gave the sounder castings, especially from the point of view of internal defects such as draws of shrink-holes?

(3) Which type of mould was the safest for production purposes and what were the reasons?

(4) Was it feasible to have one standard moulding sand mixture that could be used for green-sand or dry-sand moulds at will, by skin-drying?

(5) What was the field for the use of artificial binders in a sand so that skin-dried green-sand moulds could be made superior in every way to present dry-sand mixtures?

(6) Could a dry-sand mould be made to produce more than one casting of the same design?

These were only a few of the questions that could be profitably discussed, and of these (3) hid a wealth of knowledge—which type of mould was the safest for production purposes and what were the reasons? In conclusion, he added that he obtained in his experiments previously mentioned considerably more information than had been outlined, and if the occasion arose during the discussion he would be pleased to add a few more points of general disagreement.

Factors of Safety.

The Chairman said that Mr. Hudson had put forward six points which he thought should be considered, and it appeared that there was room for six lectures in order adequately to deal with them. In regard to (1), he considered that the hardness was certainly not due to fused sand; it was undoubtedly due to chill, and that depended on the section of the metal. He thought that it was a very light chill, however, and was confined to the surface, as could be seen when dressing the edges of small castings. Whether a casting should be made in green sand or dry sand was a question of utility and safety; it was a question which the foundryman had very often to answer; and in coming to a decision he had to weigh up the risks, and if the risk was considered too great to use green sand, then he utilised dry sand. What they had to do was to consider what they had been able to achieve in previous cases and compare with the conditions of the case under consideration and decide which would give the greater safety. As to the relative soundness of castings made in green-sand and dry-sand moulds, he thought that it was about equal. In his own experience, that had been the case. He had in mind a very difficult casting, which had thick and thin sections with large variations, where it was necessary to use denseners with either method to obtain sound castings.

In green-sand moulding they could work up to a certain size and then the question of weight came in, and the handling of the box made it dangerous. In other cases the mould could quite well be made in green sand, but it carried so many cores that the difficulty of handling made dry sand a necessity. In regard to the question of using one standard sand for both types of moulding, he thought that probably they could go much farther than they had done, but in all probability such a sand would give a rougher skin in green sand than in dry sand. In regard to the question of skin drying, he had not had much experience of it and did not feel competent to express an opinion. He hoped that the members would freely give their views and experience in this important and interesting matter which had been put to them.

Prof. Turner's Work Recalled.

Mr. John Longden said that he did not think that Mr. Hudson had answered the fundamental question, but he had put other questions which he wished answered. Mr. Hudson assumed that the fundamental question to be answered in deciding upon the manner of moulding was which type of mould cooled the metal quicker. He himself did not think that was the question at all. Nearly 30 years ago Prof. Turner produced expansion curves which showed that grey iron low in phosphorus expanded on cooling, highly-phosphoric iron expanded more and pure iron not at all. (Mr. Longden here gave a brief account of Prof. Turner's experiments.) He thought that the function of the expansions of iron had a good deal of bearing on this question of green-sand or dry-sand moulds. He then described some experiments which he had made to discover what happened during the cooling of a casting, and sketched an arrangement which he had used to measure the amount of the expansion on certain castings, particularly the keel of a small boat. He thought the question arose as to what happened in such cases, and it appeared that solidification taking place from the outside formed a shell with liquid locked inside, causing a great expansion. He had

* Foundry Trade Journal, Vol. 46, p. 7.

experience of this in a roller which was 10 ft. 6 in. long, 11½ in. dia. and ¾ in. thick. It was cast on end and the box parts were bolted together. The roller cast quite satisfactorily, but metal ran out at the bottom-part joint, so that the bottom portion of the roller as cast was quite solid but the liquid centre ran out from the portion above, leaving a shell. He said that when cast iron solidified the carbide broke down to free graphite, and as the graphite occupied more space than the carbide, it meant expansion with the exertion of a certain amount of force.

In a section of grey iron it was estimated that 10 per cent. of the space was occupied by free carbon or the spaces which had been filled with graphite. The space occupied by the carbon compound was relatively small compared with the graphite, and a great force was produced which was responsible for the growth which he found in the keel, which had previously been mentioned, and also in the roller. It was true that graphite was a fairly soft substance, but imagining innumerable plates of it being produced, the force from the action would be immense, and, to his mind, this, coupled with the crystals growing from the roller shell, forced the liquid out. He had made experiments with little cylindrical blocks; he cast some of them with steel rods upstanding and coming through the top part, with a plate across them so as to measure any movement of the mould wall. He found that in 2½ min. the green-sand wall expanded $\frac{43}{1000}$ in., whilst the dry-sand wall expanded $\frac{81}{1000}$ in. Applying those facts, a green-sand mould was like a balloon, and if fed with dull iron the wall would burst. The dry-sand mould could stand the pressure better and the voids due to shrinkage would be less.

Regarding the question as to the number of castings that could be made from one mould, the roller he had spoken of was the sixth cast and the mould was in loam. When a loam or dry-sand mould was made, it was submitted to a certain amount of pressure and became denser. In the case of the roller, six castings had been made, and the mould must have been denser and denser with the expansion of the metal. That action would go on until it broke down the loam. He knew of many cases where the mould if made in dry sand could be used a number of times, provided the contour was fairly simple. That was another advantage of dry sand against green sand. Mr. Hudson had told them that the relative chilling (which he regarded as important and which he himself queried) was an essential point. He had made some experiments with a metal containing 0.3 per cent. phosphorus and about 0.1 per cent. sulphur. He showed two plates, one cast in green sand and the other in dry sand. Undoubtedly, he said, the one cast in green sand showed a greater tendency to chilling.

Mr. Hudson said that Mr. Longden was under a misapprehension. He had not stated that green sand chilled more or less than dry sand, but he had said that the rate of cooling of the metal was the same up to 2 in. thick and relatively quicker as thickness increased. Mr. Longden had accentuated the action by using a very hard iron and undoubtedly there was a greater tendency to surface-chill in green sand than dry sand. He had had experience of some castings which had a very hard skin in green sand but they did not get it in dry sand. He had not contended that a dry sand did not chill more or less than green sand—it was the rate of cooling of the metal which he had referred to. He had purposely left out chilling in order to bring out the views of members in the discussion.

Influence of Available Labour.

Mr. R. D. Lawrie said that in deciding whether a casting should be made in green sand or dry sand it was necessary to consider the nature of the job and the number off, and also the type of pattern and the tackle available. If the foundry manager were shown the drawing and the number off he might be able to decide right away how the job should be made. He had an experience of a flywheel 11 ft. 6 in. dia. which varied in thickness from 3 in. at the outside to 7 in. at the centre, apart from twelve bosses. Some would have made it in loam, using top plate and drag plate, but he made it in green sand. Think what the job would have entailed when working from a complete pattern in loam. The difficulty was that they had not the same skilled moulders in green sand as they had 20 years ago, and it was not every green-sand moulder that could handle that weight. Anyone could make a job in dry sand but it required a very skilled man to do a big job in green sand. He rather supported Mr. Longden in his views on mould wall resistance. Years ago he had had to make cylindrical bars up to 8 in. dia. on a production basis. He made some experiments and cast three bars 6 in. dia. and 12 in. long, one in green sand, one in dry sand and one in a permanent mould. They were all cast at the same time and with the same metal. The green-sand casting shrank ¼ in., the dry-sand casting was flat on the top and the one in the permanent mould had a hump on its back, and when he thought the metal had set a little globule was shot up. That proved there was a wall resistance in the mould. The green sand pushed sideways; if the mould wall could not move out the metal was forced up. A dry-sand casting was denser than a green-sand one for the same reason.

Pressure on Mould Walls.

Mr. Robert Liddle said that he had a great deal in common with Mr. Lawrie and Mr. Longden. He had recently broken up some heads of rolls which were 30 in. long and 7 in. thick, which had been turned upside down 1½ hrs. after casting, the liquid being still fluid. He had found no sign of draws in that head. The mould was loam and the casting was sometimes very rigid. In that particular case the metal was cast cool and the walls were practically irresistible. He believed that an expansion took place during the cooling of the outside metal which set up a large pressure on the brickwork. He had found when breaking up the head that if it had been cast, say, 2 in. short, a slight draw was found but no cavity; the expansion taking place had forced the core inward. The expansion of the metal had given a denser metal than in a softer mould or one that could yield. He thought that in turning the mould end for end he would get equilibrium at the centre, but a test was made and he could not find any difference in the texture of the metal between one turned up and one not turned up. They were both very close at the bottom, more open at the middle and still more at the top. Returning to the question of green-sand or dry-sand moulding, he considered that practically green-sand moulding was not very much behind loam moulding. Forty years ago there were certain accidents and moulders went over to dry sand because it was considered much safer. He could not see why green sand should not be made to resist the pressure. In the case of the dry-sand mould it was put into the stove, and heat on the outside of the box expanded it so that a cavity was formed between the casing and the sand which never came back again and so took the pressure off the mould. In green sand the pressure was usually taken off the mould by running below the head; in dry-sand moulds run from the top a denser job was made than in green sand. Forty years ago more green-sand moulds were used, but they were specially prepared and looked as good as dry-sand castings. If they could get the men to work green sand properly it would be easier to decide which type should be used for a job. Personally he believed that both dry- and green-sand moulding would go out and the loam moulder would be able to produce his best work when he was asked for it.

Costs Compared.

Mr. A. Laurie said one or two points had to be mentioned as affecting the decision how to make a casting. He was, like some other members, responsible for the patternmaking and machining of castings, and it was necessary to weigh up everything—cost of patterns, moulding and the machining costs. Like Mr. Liddle, he made a lot of work in green sand at one time. He remembered a job he had a number off; he made a block pattern the first time, but the next time he swept up the mould. His habit was to use the material and the men he had available. He was sorry to have to say that there was a tremendous difference in the skill of the men, some being very skilled in some things but very deficient in others. He admitted that in many cases, if the job was followed right through, it was cheaper to make in dry sand than green sand because the bond of the green sand would not stand up to it. Less ramming was required on a dry-sand job, and the mould was more porous, so the metal lay more sweetly. In green-sand moulding additional attention to the ramming was necessary and it paid, for it stood the pressure better. The amount of pressure was considered and prepared for. In a rectangular job the pressure was greatest at the corners. He thought a very large factor in deciding which type of mould should be used was whether he was making the castings to sell or to use himself. If the castings were for sale, green sand would be used, as they had a large weight. The amount of finishing, sprigging and preparation needed in a green-sand mould was much more than in dry sand. There was only the fuel for drying extra in the case of dry sand and one made a good job. He had had experience of green-sand men working with a form of pattern, getting a certain production, but when the pattern was handed to dry-sand men they scored over green-sand men very often. The loam man, however, scored every time. He knew a man who would make anything, even a plain pipe, in loam. It appeared to him to be all a question how the moulder was brought up.

Green-Sand Moulds Gaining in Popularity.

Mr. Daniel Sharpe said that he was more interested in the question from the point of production by cheap methods. He thought that loam moulding would eventually die out except where the patternmaking cost was sufficient to turn the scales. He thought that the very fact that the question of green sand *versus* dry sand came up so often showed that people wanted to make green-sand moulds wherever possible. The limit, to his mind, was the type of casting, and there was bound to be a border line between green-sand and dry-sand moulding. Some of the examples which had been given were really outside the range for green-sand moulding, and he thought it would be wiser if they kept nearer to the border-line types of castings. Hardness of the skin in green-sand castings could not be denied, and they always got a certain degree of it. The discussion had almost entirely been confined to iron castings, but his own experience had been mainly steel, and in gaining that experience he came through very severe conditions. He undoubtedly found the effect of expansion, but he wished to utter a warning not to confuse the expansion of the metal with the expansion of the core. Dry sand certainly held the field for safety, and if the mould held a lot of cores or the top part had to be lifted nothing could be said for green sand. The information which he had from America and the Continent showed that much work was done in green sand that was done in dry sand here, but they appeared to work with much more porous sand and to ram very much harder. He believed that in America

they were doing something which was well worth investigation.

Physical Phenomena often Neglected.

Mr. Hudson said that Mr. Sharpe had brought forward the second objection, and he would put the third, namely, that graphite varied in the different types of metal due to shrinkage and cooling rate. That brought up also the question of gas in the metal and the use of other-than-cupola melting, such as in the Sesci furnace, which gave a metal with less shrinkage.

Mr. Sharpe said that in regard to Mr. Lawrie's remarks, there must be a border line, because there were some castings which no one wished to make in green sand, such, for instance, as a turbine casing. On the other hand there were castings which no one would dream of making in dry sand. There must be a line of demarcation somewhere between the two extremes, and he thought that it was in the vicinity of that line that they should concentrate.

Mr. Morehead said that he had had experience of expansion setting up pressure in the metal. He had cast blocks in permanent moulds and usually there was a certain amount of exudation on top in the form of small beads. He found that higher silicon iron exuded more and showed a greater expansion.

Mr. Hudson said that was the fourth point. The iron mould would not expand and therefore it was a function of the metal composition. They must take the actual cooling rate. In a chill mould they had less graphite and consequently not only a mould that would not give but less expansion in the metal.

Advantages of Loam Moulding.

Mr. Liddle said that if a green-sand moulder got a job he could make it as well as a dry-sand moulder. Mr. Hudson had stated that the percentage of moisture in the sand was a very determinative factor, and he agreed with Mr. Hudson. In the case of loam that did not arise, and also there was no border line when it came to making a job in sand or in loam. The loam man could make any job. When it came to deciding the method to give the quickest delivery at the lowest price, loam had it every time. They found, however, to-day that busy people had a hard time competing with people who had no jobs.

Mr. Longden said that he quite agreed with Mr. Liddle that a heavily-rammed dry-sand core carrying heavy irons would expand, but the core of the roller he referred to was struck up in loam.

Tackle and Quantity.

Mr. McManus said, regarding loam work, it was not a question that in the case of one-off jobs only boards and strickle were required and it was cheaper than sand, but if 10 or 20 were required loam could not compete. He thought that the question of the number off decided the process.

Mr. Longden said that he had cast an 8-ton job in six days, and that could not have been done in sand even with a complete pattern.

Mr. Hudson said that he was pleased that the discussion had been so interesting. He had purposely refrained from giving any dogmatic opinions and submitted only facts, so that the discussion might be as free as possible. His main object in bringing the subject forward was to show how comparatively simple matters which foundrymen had taken for granted might be better for investigation and discussion.

Mr. T. Greenland Davies, H.M. Inspector of Mines, presented trophies and medals in ambulance competitions at Consett on April 16. The competitions were the finals of the Consett Iron Company's Ambulance League. Mr. F. O. Kirkup, chief agent to the Consett Iron Company, Limited, who presided, said that one out of every five adult persons at the collieries had a knowledge of ambulance work.

International Aluminium Competition.

A second international competition for the development of the uses of aluminium and its alloys is being organised, and below we detail the rules attaching thereto.

Clause I—Object of Competition.—A competition open to persons of any nationality will be held by the International Aluminium Bureau with the object of encouraging the development of the aluminium industry. Prizes are offered for the best suggestions dealing with the construction of new apparatus, or with improved applications of the metal or its alloys, or with improvements in manipulation, with the object of developing the uses of these metals. The International Aluminium Bureau, being a department of the Alliance Aluminium Cie, whose head office is at Basel, Switzerland, Aeschengraben 22, competitors agree to accept domicile at Basel, for the purpose of the competition.

Clause II.—The suggestions submitted for this competition must deal with the manufacture of an article, a machine, or part of a machine, in aluminium or one of its alloys, or with an improvement in the working or use of the metal (welding, insulation, surface finish, etc.).

Clause III.—Entries should be submitted in either English, French or German.

Clause IV.—The proposal submitted must be sufficiently complete to allow the value of the suggestions to be fully appreciated. They should contain a detailed description (or model if so desired) of the article, with drawings, dimensions, weight, etc., or of the process, and should give sufficient data to admit of experimental trials to enable the claims to be verified. An economic study indicating the approximate tonnage of aluminium likely to be employed under present economic conditions, due to the suggestion submitted, should be included.

Clause V.—The adjudicating committee will be composed of five engineers, one each being nominated by each company associated with the Alliance Aluminium Cie, and, in addition, one member nominated by the director of the International Aluminium Bureau, making in all six members. The committee will regulate their own procedure in regard to meetings, methods of work, etc. In the event of an equal distribution of votes the representative of the International Aluminium Bureau will have a casting vote.

Clause VI.—The decision of the committee on the award of prizes will be final.

Clause VII.—Prizes totalling 20,000 Swiss francs* will be divided by the committee in the month of December, 1932, among the authors of the best proposals. The decision of the committee regarding the division of prizes will be final, with the condition that:—(1) at least three prizes will be awarded, and (2) no prize will be less than 2,000 Swiss francs.

Clause VIII.—The opening date of the competition will be July 1, 1932. Entries must be submitted between that date and October 1, 1932 (date of posting), after which date no entry can be accepted. All entries must be in typewritten form and must be signed by their author. They should be accompanied by a summary of not more than 300 words, in which the author states briefly the object and advantages of the invention and the new outlet which it offers for aluminium and its alloys. Duplicate copies with full name, address and nationality of the author attached, must be forwarded by registered mail to the International Aluminium Bureau, 23 bis Rue de Balzac, Paris (8e), France. No responsibility will be accepted for documents lost in transit. On receipt by the Bureau, all documents will be given a serial number which will be marked on the original MSS. and entered in a suitable register kept constantly up to date. One of the duplicate copies will be retained by the Bureau and the second copy will be sent to an engineer of one of the companies constituting the Alliance Aluminium Cie (if possible, of the same nationality as the author), who will examine the proposals and report to the committee. The committee will have the sole right to appoint the engineer or engineers who, for each country, will make these reports, and may, if circumstances demand, modify their appointments. If a competitor does not belong to one of the countries represented in the Alliance Aluminium Cie, *i.e.*, British, Canadian, French, German or Swiss, the report will be made by a person to be chosen by the Bureau. To facilitate the task of the committee, should the number of entries be great, the Bureau reserves the right of eliminating those which are obviously not of sufficient merit. The entries will be examined by the committee without delay and the results announced on or before December 15, 1932.

Clause IX.—Up to the last date for submitting entries (*i.e.*, October 1, 1932), competitors have the right to withdraw or alter their entries. After this date and before the announcement of the awards, all authors shall have the right to withdraw but not alter their entries.

Clause X.—No invention for which a patent has been granted before January 1, 1931, is eligible for an award.

Clause XI.—In order to protect their ideas, competitors may apply for letters Patent covering their inventions. The Bureau on its part undertakes not to divulge publicly the contents of the MSS. submitted for the competition which have not received an award, without due authorisation by the author so long as they remain in the possession of the Bureau.

Clause XII.—The act of submitting a proposal to the Bureau for the purpose of this competition is to be regarded as constituting an offer of the invention for sale, in the first instance to the Alliance Aluminium Cie, and then to any of the associated companies on terms and conditions to be mutually agreed. This option to purchase is granted in the first instance to the Alliance Aluminium Cie, and failing exercise by that company, the option passes to the associated companies, individually. When a number of companies desire the right of option simultaneously the order of priority will be decided by the committee of the Alliance Aluminium Cie. In the event of the Alliance Aluminium Cie or its associated companies refusing the offer, or being unable to agree on terms for acquisition of the invention, the author will resume his rights whether or not a patent has been taken out. The Alliance Aluminium Cie, or its associated companies, must intimate their intention of exercising the right thus reserved to them within three months from the announcement of awards or of the taking out of a patent. If no such intimation is made before March 15, 1933, the author resumes all rights in his invention.

Clause XIII.—Entries which do not receive an award will be returned to their authors by registered post, but the Bureau accepts no responsibility if they are lost in transit. Entries may be re-entered for any subsequent competition which the Bureau may decide to hold.

Clause XIV.—In submitting a proposal to the International Aluminium Bureau, 23 bis Rue de Balzac, Paris (8e), France, for the purpose of this competition an inventor agrees to accept all the rules and regulations as herein set forth.

Clause XV.—Employees of companies associated with the Alliance Aluminium Cie may only take part in this competition with the consent of their employers.

Clause XVI.—These rules have been drawn up in English, French and German. In the event of any difficulties arising in interpretation, the French text shall be accepted.

* *Circa* £1,000.

Steel Foundry Practice in a Jobbing Foundry.*

By C. D. Pollard (Scunthorpe).

It should be clearly understood that all the subject matter of this Paper should be considered as relating to production of steel castings in a jobbing foundry, where castings from ¼ cwt. to 20 tons or upwards are being handled. Initially, one must bear in mind the fact that unless one is producing at a remunerative figure one is not succeeding in the primary object for which foundrymen are employed in their respective positions in the industry. Therefore, the costs side of the business must have full attention whilst dealing with production. The plant lay-out in a foundry is an expensive one, and groups of men and boys cannot be employed without reasonable supervision.

The cost of steel in the ladle varies according to the method of melting and quantities required, which is often governed by the state of the order-book, and sometimes by the facilities for producing and drying moulds, but in any case the cost of steel is fairly high compared with the selling price of castings to-day. The clerical staff must be allowed for, because statistical figures, wage calculations, and estimating details and correspondence are all necessities. The strength of this section may vary with any two foundries as it is amazing how many different methods of preparing figures are adopted and considered correct in the efforts to arrive at true foundry costs. These items and the expense incurred in the employment of outside selling agents or representatives make up quite an appreciable percentage of the selling price, and in consequence the small amount which is left must be very carefully spread over the production work and purchase of materials.

Sales-Engineers.

Unless commercial representatives are in full sympathy with the foundry problems and make some endeavour to become conversant with methods adopted in their own shops, the soliciting of orders will not be a remunerative occupation, if the number of orders obtained is to be the deciding factor. Without doubt many buyers of steel castings to-day are inclined to insist that as the range in weight increases the purchase price should decrease without any consideration of design. Unless the sales representative has some knowledge of production methods, his arguments in favour of his works are not convincing, in consequence of which the buyer may be left with the impression that his own interpretation is not only justified but correct. On the other hand, if a sales representative has some knowledge of foundry work, he can make use of it to the best advantage at interviews, where the buyers are insistent on absurdly low figures, and in some cases, at any rate, prevent the cutting down in price such as is happening on a large proportion of the work which is being given out to-day.

Type of Pattern Available.

Another feature which should have attention when negotiating for an order, is the type of pattern which may be available for any proposed casting. In most cases the buyer is not concerned as to whether the pattern suits the foundry or not, so long as one is available. On the other hand, it may be that he is compelled to allow for a pattern in his buying price, and in that case it is looked upon as an extra load which must be kept down to the lowest possible figure. It is appreciated that this is reasonable from a purely buying point of view, but it must be insisted that it may be possible to reduce slightly on the cost of the castings if a concession is given on the price of the pattern. It is realised that salesmen will retaliate by insisting that their job is to sell, and not to dictate as to how the works are to produce the castings; this is quite true, but once the buyer is interested in such questions (and no doubt if propositions affecting his pocket are intelligently put forward, he is interested) the opportunity for the seller to obtain permission to approach his works people should be easier than when the whole matter has been discussed from a purely financial point of view.

Undercutting.

During the present difficult times it has been the practice of steel founders to undercut each other, in order to keep their plant and as many men as possible employed, and, as was to be expected, keen buyers have exploited this to their own advantage. In consequence of this, salesmen have been compelled to be appealing constantly to the works for reductions in quoted prices. It is quite certain that the technical representatives will receive more consideration than the non-technical men, when calling upon buyers, and, unless the caller has the greater knowledge of the product in question, the argument can only go in favour of the cheapest price.

In these days of high speeds, temperatures and pressures, it is almost useless to hope for a satisfactory order-book unless the seller knows what he is talking about, and, whereas reputation may be sufficient to bring in an order, no one can afford to rely on a good name. If a firm has a good reputation, it is entitled to make reference to it whenever it considers it to be beneficial, but it must not be satisfied to rest on its laurels.

Modern managements usually take steps to ensure co-operation between patternmakers and moulders, but they must go much further than this and have real team work which functions from the inquiry stage to delivery of the castings. The men in the shop must realise they are in the team, and the sales section must realise this also, and, when they all have this idea in mind, it is certain they will carry out their individual duties to the benefit of the whole concern.

If the foundry is organised as it should be, each individual has a job to do, and that job is of sufficient importance to justify the individual's inclusion in the team, and with such conditions there should be no overlapping, and in consequence a smooth working team. The sales and office section must realise that they would not be there were it not for the works people who are producing, and the latter must realise that, if the office and sales people were not in the team, there would be no orders calling for production. The success or otherwise of maintaining such team work has a pronounced effect on production cost figures.

Rudder Castings.

After being connected with the production of this class of work for some years, the author is convinced that the official of any foundry who claims "Alone I did it" is the person who always makes such a claim when things are just right, but hurriedly blames somebody else when things are not. Unfortunately, this is the case in some foundries, and at such places team work is impossible; they cannot possibly claim to be successful. Beginning with the receipt of the order at the works, the order clerk (whoever he may be and under whatever system he may be working) should make it his duty to issue to the works all the information regarding the customer's requirements.

Passing over the next stage—planning and progressing—it will be assumed that the drawings, etc., are in the hands of the foreman patternmaker, and it is here that the closest possible co-operation of the works technical staff is essential, if sound castings are to be produced. Patternmaking should not be commenced until a clear understanding has been reached as to methods of moulding, casting, etc.

Having reached the stage where pattern and core boxes are completed it is policy to lay them side by side before beginning to mould, in order that moulders and coremakers may each understand what is expected of them in conjunction with what the others are going to do. Amongst other things which are to be decided, are, where to vent; where to run the steel into the mould; where brackets should be attached; where to place feeders, and, if it be considered advisable, where to place chills.

Venting.

It is useless moulders carefully and thoughtfully making provision for venting unless the coremakers understand where those vents are going to be and in which direction the air and gases are to be taken off the mould. Therefore, while the pattern and core boxes are laid out together a perfect understanding should be arrived at on this very important factor. Owing to the high temperature at which molten steel is poured into the moulds, rapid expansion of the mould gases will occur, making it imperative that such gases are allowed to escape from cores and moulds to atmosphere with the least possible delay. If by any lack of understanding between moulders and coremakers, venting from cores to atmosphere is not allowed, the gases which may be confined in the cores will be subjected to an increasing heat, and therefore, expansion, which in turn means compression and the least possible trouble will be badly-blown castings. It is quite conceivable that under this compression the cores might burst, which would mean complete disaster, the core material would mix with the molten steel and a hopelessly dirty casting would be the result.

The radiation of heat from the mould face will be dealt with later in connection with the cooling of castings, but at this stage it might be considered in relation to the venting of the moulds and cores because it is important that one does not overlook the effect of the backing sand on the escaping gases.

After the steel has been poured into the mould, the radiant heat passing from the face of the mould will cause the air which lies between the grains of sand to expand at a very quick rate. This being so, ample provision must be made for the passage of air from the mould by the most direct route. It is almost certain that the facing sand will allow the air and gases to proceed on their way, because special attention is given to the preparation of facing sands, but it is also just as important that the permeability of the backing sand is equally as good. If such be not the case, a slowing up of the flow of the air and gases will be caused, and if they are seriously retarded in their movement towards atmosphere they will seek the easiest line of resistance, which may be back towards the interior of the mould, thus causing a blown casting.

It is always policy to keep a clean floor, which enables one to control the backing sand. A system of milling all backing sand at regular intervals is essential, whether light or heavy work is being produced, or whether that work be made in green- or dry-sand moulds. If green-sand work is being undertaken, the generation of steam and gases in the moulds is a much more serious matter than when dried moulds are being used, and special attention must be given to backing sand.

Brackets.

The placing of brackets in moulds and cores is an important factor in the production of some steel castings, and while it is an advantage to

* A Paper read before the Sheffield Section of the Institute of British Foundrymen, Mr. G. L. Oxley presiding.

use brackets as an aid to soundness, it is also a disadvantage to add brackets indiscriminately without satisfactorily proving that they are to be serviceable.

Change of section, supporting ribs, which may, for example, be dividing walls in the internal portion of castings, and the attachment of feeders, make it necessary for moulders and coremakers to consider carefully the placing of brackets at correct positions. Brackets are intended to help to prevent pulling, and the time to decide where to fix them is during the discussion whilst the pattern and coreboxes are side by side prior to the commencement of moulding, not as an afterthought during the closing of the moulds.

Moulders are called upon in some cases to arrange for bracketing castings, because of internal design, and coremakers must make similar provision because of external influences, thus proving the necessity for co-operation of all who are concerned with production. In some cases it is easy to mark clearly on a pattern where internal ribs join up with the outer casing of the casting, and in such cases the moulders have the opportunity of fixing brackets accordingly, but in the majority of cases on complicated jobs the marking on a pattern only shows a small proportion of the internal structure of the casting, and then an examination of pattern and coreboxes together is the safest method of preventing a misunderstanding.

Opposite each row of brackets in turbine castings there will be cross ribs in the castings when it is poured, and owing to added sectional area at the junction of the outer wall and cross ribs local weakness will be caused by uneven cooling. Because steel contracts $\frac{3}{16}$ in. or more per ft. in this cooling-down period, it is necessary that provision be made in the mould for as much movement as is required whilst contraction is taking place, but it is advisable at times to give support to the castings at the weak places, and brackets are one of the means adopted.

The size and thickness of the brackets are rather important, because, if they are to function correctly, they should cool off very quickly, and be in a solid condition before the main body of the casting, in order that they may have sufficient tensile strength to act as ties across those weak places in the casting, which are caused by slower cooling at the junction of walls and ribs or other such local hot spots. It is noticeable that the added mould surface given by these brackets offers freer radiation from that surface, thus causing a more rapid cooling which counterbalances to some extent the effect of added area.

Considering a little more closely what happens at metal junctions during the cooling period, after pouring has been completed, re-entrant angles of sand are the parts of the mould which are liable to get into the hottest condition, because of the radiated heat flowing in two directions at these particular spots. The effect of this on the casting is to keep it hot locally, in addition to which the added sectional area has also a tendency to keep this local place hot, which results in the centre core of the junction of walls and ribs being much hotter than the surrounding steel during the later stages of cooling. If direct feeding be impracticable at such places, and chilling is not resorted to, a contraction draw will be the result, in consequence of which three lines of weakness are created. Pulling is liable to take place at one or more of these points, if the normal travel of the casting structure is at all retarded during the cooling down from liquid to solid condition of the steel.

Further, it is quite feasible that gases which are given off the cooling steel will have a tendency to accumulate in the hotter core, resulting probably in blowing trouble at the internal corners of the casting. Examination of some steel castings will reveal small blow-holes at the corners, and, if these were investigated, cavities would be found in the region of the black spot. Blowing trouble may also result from the overheating of the sand at the dark shaded portions, because the high temperature and compression causes the fusion point of these hot spots of sand to be lower than the remainder of the mould face.

Runners.

When orders are required, there must be a clear understanding between moulders and coremakers what is involved in the running of any casting which is to be produced, because the venting of the cores is often governed by the position from which the steel is run into the mould. It may also be that the method of running a casting influences the decision as to what material to use when making up the cores. Generally speaking, bottom runners are advisable, and, whenever it is possible to run a casting from the bottom, it should be done. By so doing it is easier to place the runners in positions which do not cause the flowing steel to impinge on to inserted cores or projecting parts of the moulds. Erosion of the cores and moulds by inrushing steel must be avoided, and bottom running is one means of preventing it.

When deciding the position of runners on a large heavy casting, it is advisable to take care that at the particular place where the runner joins the casting a good head of steel is available, because the continued flow of steel past this one position will create a considerably hot spot in the mould. Realising this and the fact that the hottest steel in the whole casting will be adjacent to this position, it will be readily understood that provision must be made for feeding this particular area of the casting, otherwise contraction cavities will develop. Of course, as the shape and size of castings vary, so the methods of running must be varied, and as many illustrations and opinions have been given regarding medium- and small-steel castings in recent issues of The Foundry Trade Journal, the running of a large steel casting will be dealt with.

A casting for a stern tube for a large ship measured roughly 28 ft. long, plus feeder head, 4 ft. 2 in. dia. over the collars and 2 ft. 7 in. inside dia. Its weight as cast was 32½ tons. It will be appreciated that so long as the steel remained liquid in the mould during the pouring of the casting, the bursting strain at the lower end of the mould would be a serious factor for consideration. Undoubtedly such a casting should be bottom poured, because of the possibility of damage to the mould if one attempted to pour direct into the mould aperture from the top.

To minimise the risk of a burst out at the lower end of the mould it was decided to fill the mould to a height of about 10 or 12 ft. from the bottom runner and then take the ladle over the open head and fill the remaining part of the mould from the top. The reason for this was to discontinue putting hot steel into that part of the casting which it was desired should be the first to cool off, in order to cut down the liquid pressure as much as possible. The down runner was formed entirely by fireclay sleeves, and the stream was broken approximately halfway down by taking it in a horizontal direction for about 12 or 14 in.; then down again and upwards by means of a " U " bend at the bottom into the mould aperture.

Before leaving the question of running steel castings, it seems desirable to deal with the placing of chills in conjunction with runners. If one so places the in-runners at such a position as to direct the flowing steel past inserted chills (unless the castings are very small and the mould is speedily filled), those chills are not acting as chills in the sense that was intended. What is meant is, that the chills are chilling the steel which is required to flow into other parts of the mould, whilst the chill itself is no longer acting at the position in which it has been inserted, because the inrushing steel has heated it up probably to almost melting temperature. Chills should not be placed where they will be in continued contact with the steel in its hottest condition.

Speaking of chills, unless the author was almost forced by circumstances to insert them, he would not do so, as they may be a blessing or they may be otherwise. If chills be resorted to, it is imperative that they be clean and dry when the steel goes into the moulds, otherwise the generation of gases and steam from the deposit on the chills will cause blown castings.

External chills also have their advantages and disadvantages, but in face of all the good things said about them the author would not use either internal or external chills unless in exceptional circumstances.

Feeding.

The heading and feeding of steel castings is a subject to which founders do not give sufficient thought, and one which has been neglected at technical meetings. It is possible to make good, sound, solid castings without feeders, but the percentage of the total production of steel castings which are so produced is very low. By means of chills some of the smaller classes of steel castings are being made with practically no feeder heads attached, but heavier section and larger types of castings call for carefully placed feeders if soundness is to be obtained.

Because of the shrinkage which takes place in steel castings during the initial cooling period, serious contraction cavities will occur unless steps are taken to supply sufficient liquid steel to follow up with a feeding process. Therefore, if piping at the heavier sections is to be averted feeder heads must be placed at suitable positions on the castings in order that while gravity because of contraction is taking liquid steel downwards, a reserve is held in the feeders to compensate this movement.

It is not possible to adopt the same methods to keep heads open on steel castings as are adopted in iron practice, because of the much higher freezing temperature of steel. Whereas it is the practice to keep pouring a supplementary supply of hot metal into the heads of iron castings some considerable time after the mould has been filled, the heads on steel castings crust over and prevent such an advantageous operation. In consequence of this, in the case of the latter, a liberal allowance must be added for feeding purposes, when the initial pouring is carried out.

Owing to the high cost of steel in the ladle one cannot afford to waste any of it, and this fact is not always borne in mind when heads are being shaped and arranged for in the shops. When the quantity required from any particular pattern warrants machine moulding, the heads should be formed by the tackle provided in the pattern shop, because it is advisable to lay out machine moulding tackle, complete with runners, heads, etc., and providing the feeding of the castings has been well thought out, efficient uniform heads are attached to the castings. In the production of odd jobs, however, whether large or small, it oftens occurs that the apertures which are to cater for feeding material are cut into the moulds, and queer shaped heads are sometimes the result.

It is possible to carry out effective feeding with 30 to 50 per cent. of excess material over and above the net weight of the casting being produced, if the heads are correctly shaped and placed, where 100 per cent. of excess would not accomplish it, if badly designed heads were attached. The effect of bottle-necking the feeder is to cause a quick rate of cooling at that position where the steel should be in a liquid condition longer than any other portion of the casting. Gravitation will continue to take place so long as liquid steel is present and a downward path is open. It has been argued many times that height is a vital factor with heads of an

almost parallel section in order to derive benefit from liquid pressure. Personal opinion is, however, that if the head had been three times the normal length, more efficient feeding of the casting would not have been carried out. Any amount of height would not prevent the solidification of that portion immediately above the base of the feeder, in consequence of which continuous downward movement of any liquid steel that may remain in the upper portion of the feeder is prevented.

With an oval shape there is less radiation of heat from the steel immediately after pouring is completed, because that has less surface area than the rectangular heads. Further than this, with the globular shape, instead of being almost parallel throughout its length, the cross-sectional area of the feeder is substantially increased, which means less detrimental effect from radiation on that reserve of liquid steel which should be continually feeding downwards, while contraction and gravitation is taking place. Of course, it is possible to produce solid steel castings with badly-designed heads, but only when such heads are in ridiculous proportion to the castings to which they are attached; then a colossal waste of material is effected, and the net weight of the castings produced is a very small proportion of the gross weight of steel poured into the moulds.

Sand.

This subject has had attention in the leading technical journals for some considerable time past. Useful experiments and tests with practically all available moulding sands have been carried out at various technical institutions, and Sheffield founders are fortunate in having such valuable work done by one of their own members (Dr. Skerl) and his colleagues at the Sheffield University. It is suggested that the published works of these scientists be closely followed and used as a basis for sand control in the shops. Of course, the first consideration to be borne in mind throughout steel-casting production is costing. One may purchase sand at a cheap rate, but, to judge its true value, it is necessary that the fettling costs are controlled in addition, and also the waster bill, because something attributable to inferior sand may be found there.

All founders think the strip associated with their castings is as good as that obtained at other foundries, and in consequence they are inclined to be guided by results and comparisons in their own shops, and make their choices of sand on this basis, but a comparison with what other people are doing is generally a means of bringing about some form of improvement at home. Opinions as to what is the best sand for steel-casting production vary considerably, and, whereas a naturally-bonded sand with the addition of a quantity of washed silica sand is used in some shops, it is the practice in others to use various grades of synthetic sand, made up to special mixings which are considered to be supreme. Personal opinion is that steel moulding sand should not be milled in a heavy roller mill, but rather in the disintegrating and aerating type of mill, where the grains are given plenty of scope for taking on to themselves a thin, even coating of bonding material. The grains should be even in size and without doubt spherical in shape.

Moulders' composition is to some extent being superseded in this country by sand, though not so quickly as on the Continent and in America. This is a step in the right direction, because compo has always been an expensive proposition, as well as to a certain extent of variable quality. In the production of large and heavy steel castings, compo has been used because founders were afraid that sand would not stand up to the pressure that would be imposed on it at elevated temperature. The moulds for large castings are also subjected to high temperatures for a considerable length of time after the pouring has been completed, so that this fact, coupled with the pressure on account of the weight of steel in the mould, caused them to be cautious and to make use of compo, the fusion point of which is higher than sand, particularly under pressures at sustained high temperature.

Annealing and Treatment.

Having produced the castings, the necessity arises for putting them into a suitable condition for service. In the cast condition they have a coarse crystalline structure and varying in degree with different analysis, are brittle and are not resistant to shock; therefore heat-treatment of some type must be carried out to bring the castings within the true limits of their physical capabilities.

This object is achieved on a large proportion of general engineering castings by straight annealing because they are made from straight carbon steel. According to design, such castings may be either cooled slowly in the furnace or cooled quickly by drawing the furnace whilst the castings are still at high temperature. From the mechanical-test standpoint, it is sometimes policy to cool carbon-steel castings quickly from the annealing temperature, but where the sectional area is opposed to fairly uniform cooling through the castings, it is certainly a risk to air-cool them. It is even policy to water-quench castings of this composition sometimes, in order to meet test requirement, but again one must be governed by design before agreeing to carry out this procedure.

In the manufacture of steel castings of intricate design and even straightforward plain castings, distortion is likely to occur at various stages. Distortion during the initial cooling cannot be avoided, but it may be possible to anticipate what will happen and counteract it by making the necessary allowances when the patterns are made.

Distortion during annealing will occur if castings are not carefully packed when they are placed in the furnace, because the unsupported parts are sure to sag, whilst the castings are being heated to the required temperature. On the other hand, when castings are distorted before being put into the annealing furnace, it is policy carefully to check them over and set them to correct shape whilst the annealing treatment is being given. There can be a saving in cost by this arrangement, instead of the method of pressing and clamping castings in order to set them to correct shape after they come from the annealing furnace. Of course, there is a limit to either method which is governed by the size and type of the castings being dealt with, but the annealing-furnace method appeals to the author except where castings are small and made in large quantities.

Careful study of the methods of dealing with large and heavy castings is essential in order to keep wasters down to the minimum, for no matter how careful everybody may be in the handling of heavy work, fractured castings at various stages of manufacture do occur. One of the reasons for this state of affairs may be the heating of the castings too quickly in the annealing furnace, or causing them to be heated unevenly, that is to say, getting some parts hot at a much quicker rate than others, such as would occur in the ordinary gas-fired furnace, where the gas inlets are in the side walls and the castings are so placed that the flames impinge directly on to them.

To heat rapidly intricate or heavy-section castings causes local stresses to be set up in them, because the internal portions of the castings cannot possibly be heated at the same rate as the outer surfaces and adjacent parts; therefore, a vastly different rate of expansion takes place through the sectional areas. Under these conditions certain parts of the castings may be stressed beyond their limit, and fractures would be the result whilst the castings were being heated. If, on the other hand, the heating up has been satisfactory, and correct temperature maintained for a period sufficient thoroughly to soak the castings, cooling is allowed to proceed too rapidly, and a different rate of contraction is created.

The inner portions this time are cooling off much slower than the surface and adjacent parts, and seriously stressed castings would be the result. The cooling stresses may be so high that they exert themselves and fracture the castings before they are actually cold. It does happen, however, that such cooling stresses are just inside the limits of the physical properties of the steel, and fracture does not immediately occur, but as soon as the castings are subjected to shock or varying temperatures (even the difference between night frost and day temperature) some time after the removal of the castings from the annealing furnace, breakages will be experienced.

This is because of added stresses due to shock or alternating expansion and contraction coupled with the stresses already existent because of uneven cooling, which load the steel beyond its capabilities of resisting such conditions. This state of affairs does happen, even when the physical properties of the steel as expressed by tensile or other test figures prove the material to be in a satisfactory annealed condition. Alloy steel castings call for very special care in handling immediately they are cast. The range of alloy steels from which castings are made is a very wide one, and it would be almost useless to make reference to any one type, because in all cases the heat-treatment must be carefully carried out in accordance with the analysis of the steel. Pyrometric control of temperature during the annealing or heat-treatment of castings is important, and under no circumstances should guesswork be allowed during these operations.

Welding.

It is nowadays quite in order to refer to welding when dealing with the production of steel castings, not only because of its aid to foundrymen, but because of the amount of fabricated steelwork that is being carried out to-day, and has been the cause of diverting quite an appreciable amount of work from the foundries. At one time welding was looked upon by designers and engineers as a curse, and to a certain extent foundrymen were to blame, because risks were taken in repairs and bad workmanship was allowed. The customer, engineer or somebody else with whom welding was being discussed would regularly say: "We cannot allow welding because we are afraid it will come out." The author is not sure whether that was reasonable ten or twelve years ago, but there is no excuse for the foundrymen who allow that to be said of their work to-day.

Fabricating by welding is being resorted to on highly-stressed work, and if such be the case, surely designers and engineers have confidence in welding. Therefore, the man who wishes to make good any small defects on his steel castings must take steps to ensure his welds being as good as the best welding which is being done in fabricated work. One cannot weld on dirt, slag or any other non-metallic matter, and this would be a good motto to mount over the welding benches in steel foundries. Never seek permission to weld a job which one knows ought not to be welded. Ascertain that it is safe, and, if in doubt, ask somebody who knows the service conditions thoroughly, because, if risks are taken, serious damage may result. Not only that, but it will probably result in somebody being prevented from carrying out a reasonable welding proposition at some future date.

Planning and Progressing.

Schemes for controlling output and deliveries from the foundries are almost as numerous as the foundries themselves, and no doubt they have all their good points, but the scheme which does not plan out the work expected from every section during the given period is of not much use to the foreman concerned. It is only natural that the foreman of each section will look after

his own interests first from the output standpoint, and unless he be guided as to what is expected of him to enable the foundry as a whole to meet its commitments, the delivery dates required by customers will not often be met. To aim at rigidly planning all the work in a jobbing foundry is not a wise man's ideal, because there are so many pitfalls awaiting the scheme.

The patterns after being issued to the moulders need adjustments for some reason or other, boxes are not at liberty, the men or boys who are most suitable for a particular job are tied up on another unfinished job, and many other everyday hindrances will prevent that smooth running of the elaborate planning system which is necessary if the system is to lead the works and not follow them, and it then becomes just a record of what has been done.

The aim of the foundry as a whole is to maintain a definite weekly tonnage output and in consequence individual foremen must do the same from their particular section. Coupled with this is the problem of the customers' delivery requirements, and when output is down and delivery dates are not met, the foremen are called on for an explanation.

As a rule this explanation savours of an excuse in the mind of the manager, and no matter how legitimate the reason for failure may be, the management are really more concerned as to the fact, rather than the cause of the failure. Therefore, if when orders are received dates for progress are planned and periodical instructions are given to foremen (say once a week) as to what is expected of them, to maintain the average weight output, delivery requirements, the responsibility is in the right place and the failure to carry out the instructions is on record each time the new programme is made out, thus cutting out the necessity for excuses and explanations later on. The planning of the work in the jobbing foundry should be under the direction of the manager himself, because he is in the position to instruct each foreman what is required of him, and to guide him in the production of those requirements. Team work in this business of planning is an important factor, because it is of no use one section accepting the help of enthusiastic people who are continually issuing reminders, and by their co-operation keeping within the reasonable limits of expectation, whilst some officials are working out their own salvation with only a faint realisation of their obligations to the other sections and the customers.

In conclusion the author wishes to thank his employers, Messrs. Thos. Firth & John Brown, Limited, for permission to present this Paper and to his colleagues on the staff who have prepared the slides for him.

Publication Received.

Index of Economic Reports.—Published by the Metropolitan Life Insurance Company, Bush House, Adelphi, London, W.C.2. It requires no less than 72 pages to list the reports which have been issued by the company. A number—may be a dozen—are devoted to foundry practice.

Duplex Process Rails.—Mr. E. A. Wraight, Metallurgical Inspector, Indian Stores Department, recently carried out an investigation with the object of comparing the physical properties of rails produced by the duplex and open-hearth (basic) process. The work was done with the co-operation and in the plant of the Tata Iron & Steel Company, Limited, at Jamshedpur. A brief survey of the results obtained should dispose of the prejudice that rails produced by the duplex process are in any way inferior to those obtained from open-hearth steel. The composition of the metal in the case of the open-hearth ingots and the ingots produced by the duplex process is very similar, especially the carbon, manganese and phosphorus contents, and the results obtained from duplex rails compared very favourably with those of the open-hearth product.—"Indian Engineering."

A Sliding Scale for Oncost Charges in Foundries.

In a recent number of the "Archiv für das Eisenhüttenwesen" there was published Report No. 50 of the Works Economy Committee of the German Ironmasters' Association, in which Dr. Cromberg developed the application to the distribution of foundry oncosts on the time basis dealt with in his recent Papers to the Iron and Steel Institute. The October issue of the "Archiv" contained Report No. 52 of the same Committee, by Hermann Jordan, describing a system of dealing with oncosts, which has already been adopted in a number of foundries. This gives valuable information about the composition of these oncosts and at the same time provides guidance for the selling policy.

It is a development of the system of "standard charges" which has been known for a long time, these being based on what is regarded as normal employment of the foundry, such as, for instance, 80 per cent. of the maximum capacity, a certain proportion of the previous year's production, etc. As a general rule, the actual charges and those thus calculated as "standard" or "normal" do not balance, the difference being carried to the profit and loss account.

In the recently introduced "sliding scale" system the oncosts are distributed over the working hours, but account is taken of the fact that all the charges are not directly proportional to the time taken. They are therefore regarded as coming under three categories: (1) fixed charges, (2) those dependent upon wages, and (3) those dependent upon weight. Investigation of the oncost charges in a number of foundries over several months has shown that they can be divided in this manner. The costs to be put in the different classes are fairly obvious, except that a portion of the starting-up costs, fuel, electricity, steam and compressed-air consumption, wages of labourers and other charges which are commonly regarded as proportional to output or to wages, is included in the fixed oncosts since these expenses cannot be reduced below a certain minimum so long as the plant operates at all.

An example is given of a foundry in which the fixed charges amounted to 15,000 mks. (about £750) per month, those dependent on weight to 19 mks. (about 19s.) per ton of production, while those proportional to wages amounted to 2 mks. per mk. of productive labour. The monthly charges calculated from these factors agreed very closely with the actual from October, 1930, to April, 1931, when improvements were introduced which reduced the charges proportional to wages to 100 per cent. instead of 200 per cent.

The variation in the charges for different classes of work can be shown by putting

k_1 = charges proportional to wages, in marks per production hr.,

k_2 = charges proportional to weight, in mks. per ton of output.

t_1 = production hrs. per ton of output.

The sum of these items of oncost is $U = (k_1 + k_2/t_1)$ mks. per hr., which increases as t_1 is reduced. In the case given, taking the wages per productive hr. at 1 mk., so that $k_1 = 2$ mks. per hr., then for $t_1 = 19$ hrs., $k_2/t_1 = 1$ mk. per hr. and $U = 3$ mks. per hr., *i.e.*, 300 per cent. on wages. If, however, $t_1 = 2$ hrs., k_1 still is 2, but $k_2/t_1 = 9\frac{1}{2}$ and $U = 11\frac{1}{2}$ mks. per hr., *i.e.*, 1,150 per cent. on wages. The fixed charges can similarly be dealt with on an hourly basis, on the assumption of a standard capacity. Thus with fixed charges of 15,000 mks. per month and normally 5,000 production hrs. per month, they amount to 3 mks. per hr., which is to be added to the varying value of U as found above. This illustrates the "sliding scale" method and shows that the various products in a foundry should have different percentage additions on wages, these being greater as the number of production hrs. per ton is less.

This fact is already taken into account in many foundries by classifying the castings in a number of grades with different oncost percentages, say (1) simple castings, (2) medium castings, and (3) intricate castings. The "sliding scale" with its continuous variation is quite easily applied, and avoids the abrupt changes which occur in passing from one grade to another. There is always uncertainty about the classification of some castings, which may show either a substantial profit or a corresponding loss, according to the grade in which they are more or less arbitrarily placed.

A consideration of the effect of changes in the various factors comprised in the oncost charges shows that a reduction in the fixed charges and in those dependent on wages has most influence in cheapening the production of castings, which involve a large number of production hours per ton, whilst the reverse holds good for those charges dependent on weight.

A proper appreciation of the actual costs of manufacture is vital in determining whether a given price is profitable or not. It will be obvious that the value of U above represents the minimum price for a particular casting, below which, not only is there no contribution made to the fixed charges, but the execution of the order causes direct expenditure in excess of the price received.

Papers for the Newcastle Conference.

Below we list the Papers to be presented at the forthcoming conference to be held in Newcastle-upon-Tyne, June 8 to 10, under the Presidency of Mr. Victor Stobie.

Wednesday, June 8.

Presidential Address.

No. 503.—"Some Notes on Moulding and Pouring Practice," by J. Pillon. (*French Exchange Paper.*)

No. 504.—"Quantity Production of Grey-Iron Castings," by J. O'Sullivan. (Henry Ford & Son, Limited, Cork.)

Thursday, June 9.

Session A. No. 505.—"Hardening Cast Iron—Hardened and Tempered and Nitrogen-Hardened Cast Iron," by J. E. Hurst (Member), Sheepbridge Stokes Centrifugal Castings Company, Limited.

No. 506.—"High-Test Cast-Iron Developments in the United States," by R. S. MacPherran, Allis-Chalmers Manufacturing Company, Milwaukee. (*American Exchange Paper.*)

No. 507.—"Distortion and Camber in Castings," by E. Longden (Member), Craven Bros., Limited, Manchester.

Session B. No. 508.—"Ferrous and Non-Ferrous Metals in the Foundry," by W. Rosenhain, D.Sc., F.R.S.

No. 509.—"Some Lifting Considerations in a Jobbing Steel Foundry," by F. J. Hemming (Member), F. H. Lloyd & Company, Limited, Wednesbury.

No. 510.—A *Résumé* of the Work of the Malleable Iron Sub-Committee of the Institute's Technical Committee.

Valve System of Regenerative Furnaces.—Sexten Wohlfart, in a recent issue of "Jernkontorets Annaler," discusses the various requirements, to which such a valve system should answer. A new valve constructed by the author is described. For a furnace with four regenerators the system consists of four slide valves and four disc valves. One valve of each kind is operated with one and the same wire. The slide valve being much heavier than the disc valve, the former cannot open until the latter is closed. When the disc valve is closed, the slide valve may be fixed in any position desired.

This Week's News in Brief.

Trade Talk.

The directors of Babcock & Wilcox, Limited, have decided to transfer the work hitherto carried on at the Lincoln works to Renfrew and Dumbarton.

Messrs. F. J. Ballard & Company, Dudley Road, Tividale, Tipton, Staffs, manufacturers of enamelling and japanning stoves, have changed their telephone number to Tipton 1281-2.

Hall Russell & Company, Limited, Footdee, Aberdeen, have secured a contract from Messrs. Ellis & M'Hardy, Limited, Aberdeen, for the building of a steamer of about 1,100 tons carrying capacity for service in the coal-carrying trade.

The cargo steamer "Harmatris" has been launched by Messrs. Lithgows, Limited, Port Glasgow. The vessel is of 9,000 tons deadweight and is the first of five steamers which the firm are building for Messrs. J. & C. Harrison, Limited, London.

Messrs. Starkey & Hawker, iron and steel merchants, are starting the erection of works at Willenhall for the production of steel strip. Production will be about 50 tons weekly. A new company, Ductile Steels, Limited, is to take over the existing firm, but Messrs. Starkey & Hawker's business at Wolverhampton, and the branch at Smethwick, will be continued.

The British Thomson-Houston Company, Limited, are manufacturing for the Government of the Punjab, India, for the Uhl River Hydro-Electric Scheme, transformers and switchgear for seven 132,000-volt substations and for eight 66,000-volt substations, to which power will be supplied by four 12,000-kw. water-wheel-driven alternators. For the Tummel Generating Station of the Grampian Electricity Supply Company B.T.-H. are manufacturing two 20,000-kw. water-wheel-driven alternators.

Bailie H. J. Kennard presided over a meeting of the Falkirk "Safety First" Council on April 19. There was a large attendance of members and representatives of the foundries in the district, and interesting schemes were advanced by members of the council with a view to further fostering the work of the body, and it is hoped that some of them will be able to put into operation in the local works at an early date. It was also decided to institute a schools propaganda committee and an industrial safety-first committee.

The American steel industry represents a capital investment of $5,000,000,000 and employs nearly 1,500,000 people, according to "The Index," published by the New York Trust Company. The steel industry, it is stated, has taken full advantage of the lower rate of activity during the past two years to effect important economies in operations, complete modernisation programmes and introduce new technical improvements designed to lower costs. It is generally estimated, for example, that the steel industry passed from the profit area when its operation dropped below 50 per cent. of capacity. Owing to operating economies, etc., it is now estimated that the industry will re-enter the profit area when operations increase to between 40 and 50 per cent. of capacity.

Messrs. Davy Bros., Limited, Park Ironworks, Sheffield, announce that under an agreement recently entered into they are the sole manufacturing agents and representatives of the Watson-Stillman Company, of New Jersey, for Great Britain, and possess sales rights for most of Europe; consequently they are now in a position to supply any item of the Watson-Stillman range of products, including:—Hydraulic plastic moulding presses (plain, heating, chilling, semi-automatic, tilting-head and angle moulding types); hydraulic extruding and straining presses for insulating materials; hydraulic presses for wheel forcing, flanging, baling, lead extrusion, etc., and accessories, such as pumps, accumulators, valves, packing and pit jacks, etc. The Watson-Stillman Company recently purchased the business of the Burroughs Company, of U.S.A., and thereby added a further range of products to its list of plastic moulding equipment. The effect of this agreement, added to the experience of Messrs. Davy Bros., Limited, in the manufacture of hydraulic presses, is to enable them to supply plastic moulding machinery embodying all the latest designs and improvements.

Company Meeting.

Hadfields, Limited.

In his address as chairman at the annual meeting of Messrs. Hadfields, Limited, Sheffield, Sir Robert Hadfield said that they were met in a time of unexampled financial disturbance throughout the world. Probably never before had there been such a time of universal distress. At their own works during the good year of trade (1927) they employed 5,291 workers and staff, as against less than 4,000 at the present time. There were probably three main causes for these serious troubles and until they were dealt with it would seem vain to hope for any real and permanent change for the better. The first of these referred to reparations, with its huge and impossible sums to be handled as matters now stood. Secondly, there were war debts, with equally heavy sums to be dealt with. Thirdly, there were monetary or currency conditions; apart from reparations and war debts, owing to the tremendous increase in world trade which had occurred during the present century, it would seem doubtful whether our currency system as at present constituted and apparently based upon gold, was sufficiently strong to carry us through. Until reparations and allied debts were dealt with and the difficulties connected with them solved it was almost impossible that there would be any real recovery of trade conditions. The chairman spoke of the great difficulty of carrying on the administration of extensive works like their own on the diminished output of to-day. They were working at considerably less than half their normal capacity, having at the same time all the necessary complicated and costly mechanism of personnel and plant capable of handling the very much larger output. For example, their steel capacity to-day was not so far away from that of the war output. Their record weekly output of steel during the war period (1917) was no less than 2,554 tons; it was now almost difficult to maintain even one-third of this output. For two years now the demand for their products had been dropping with the general stagnation in industry and each successive drop had created new problems of how to adapt the large units of which their plant consisted to deal with the position. The trading results shown in the accounts might appear disappointing, but it was no mean achievement to have maintained a manufacturing profit at all in the circumstances of to-day.

Company Reports.

Harrison (Birmingham), Limited.—Dividend of 20 per cent., tax free.

Associated Electrical Industries, Limited.—Profit, £284,829; brought in, £110,411; debenture interest, £41,454; depreciation allowance, £74,937; dividend on the ordinary shares of 4 per cent. for the year; carried forward, after payment of preference dividend, £99,899.

Babcock & Wilcox, Limited.—Profit, £569,620; brought in, £49,793; transferred from dividend equalisation fund, £50,000; to staff pension fund, £19,837; final dividend of 7 per cent. on the ordinary shares, making 14 per cent., less tax, for the year; carried forward, £32,671.

New Companies.

A. E. Law & Company, Limited, Crown Street, Wolverhampton. — Capital £350. Ironfounders. Directors: F. E. Brooker and A. E. Law.

Amri Manufacturing Company, Limited, 231, Strand, London, W.C.—Capital, £3,000. Metal goods. Directors: C. U. Hasenburg, F. D. Spencer and G. K. Wright.

Urgently Required.

Thermal Alloy.—We are requiring the names of the manufacturers or British agents of this alloy, which we understand is of the nickel chrome type.

Foundry Trade Journal.—We are urgently requiring a complete set of back copies of The Foundry Trade Journal from Vol. 1 (1902) to 1928 inclusive. Offers to be made to The Publishers, The Foundry Trade Journal, 49, Wellington Street, London, W.C.2.

Personal.

Mr. Herbert A. Lingard has been elected a director of the British Thomson-Houston Company, Limited.

Mr. George Barnard, Birmingham and Midland district engineer and manager for Messrs. Callender's Cable & Construction Company, Limited, has completed 50 years of service with the company.

Mr. A. E. Osborn, who was elected President of the Staffordshire Iron and Steel Institute for the session 1932-33 at the annual meeting on April 19, is manager of the ships' cable and anchor department of Messrs. N. Hingley & Sons, Limited, and has had a long experience of forging work. He was a Vice-President of the Institute from 1930-1932, and has been a member of the Council since 1924.

Will.

Davis, F. H., of Messrs. Smith & Davis, Limited, brassfounders, Birmingham £8,451

Obituary.

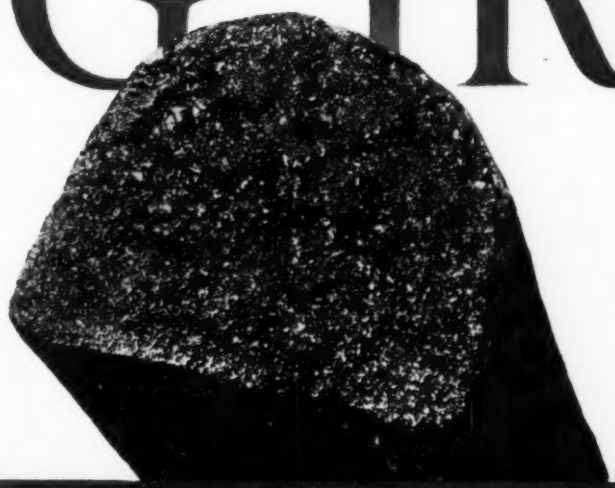
Mr. James Walker, a prominent Glasgow business man, of the Achilles Steel Company, died suddenly on April 23. He appeared to be in good health until about noon, when he entered a room adjoining his office, and was found lying on the floor dead a little while later.

Mr. James Walker, foreman moulder, was instantly killed in the Lanarkshire Steel Works, Motherwell, and his assistant, Mr. William Mackenzie, was severely injured. The two men were examining a mould, the top part of which had been lifted and suspended on a crane. The rope holding the top part slipped from the jib, and the mass, weighing 5 cwts., fell on to the men.

Mr. E. C. Keay, chairman of Messrs. E. C. & J. Keay (1926), Limited, constructional engineers, of Birmingham and Darlaston, died at his home at Edgbaston on Saturday, April 16. He was in his 80th year. The son of Mr. James Keay, formerly a South Staffordshire ironmaster, he received his education at Leamington. His father died when he was seventeen years of age, so that he was faced at an early age with the responsibility of conducting an important business at West Bromwich. This he did with such success that the business rapidly developed, and acquired a considerable reputation. Mr. Keay was also a director of the Loddington Ironstone Company, Limited, and the New Cransley Iron & Steel Company, Limited. Formerly he was chairman of Messrs. C. Akrill & Company, Limited, of West Bromwich, but he retired from this position owing to ill-health.

Mr. E. Le Quesne Herbert, late of Allied Ironfounders, Limited, died at Newcastle-upon-Tyne on April 18. Mr. Herbert, who was in his 66th year, was for many years an outstanding personality in ironfounding circles in Falkirk and elsewhere. A poignant fact associated with his death is that he had only been retired from active participation in the affairs of Allied Ironfounders for the brief period of four weeks, and arrangements had been made to mark his retiral by the presentation of a tangible token of appreciation of his services to the industry. He was taken ill with pleurisy on April 14 after after attending several meetings. A native of the Channel Islands, Mr. Herbert was for a number of years representative of Carron Company at Newcastle, and just over 20 years ago he took over the general managership of the Callendar Iron Company, Limited, Falkirk, which position he held until in 1922 he left to become sales director to Light Castings, Limited, at Stockport. Three years ago he returned to Falkirk and became managing director of M. Cockburn & Company, Limited, Gowanbank Iron Works. On the amalgamation of a number of foundries, including Gowanbank, into what is known as Allied Ironfounders, Limited, Mr. Herbert remained in the active management of Gowanbank Foundry with increased responsibilities, and continued to do so until his retiral four weeks ago. He had, however, retained his connection with Allied Ironfounders as a director. Mr. Herbert was prominently identified with the work of what was formerly known as the National Light Castings Employers' Association, of which he was a very active member. He was also chairman for the Falkirk district of the Ironfounders' Federation and was an able negotiator in the settlement of disputes which arose within the industry, especially the rainwater section of the light-castings industry.

PIG IRON



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Raw Material Markets.

The new duties, ranging from 15 to 33⅓ per cent. *ad calorem*, on foreign steel and iron and steel manufactures have considerably quickened market interest. It is fully realised, of course, that considerable stocks of foreign semis and finished steel are held in this country, but at the same time the additional protection should give a welcome impetus to the manufacture of home-produced iron and steel. No fresh duty has been put on foreign pig-iron. On the other hand, the home makers of foundry products have been granted much-needed additional protection. The protection against foreign price-cutting, coupled with a further reduction of the Bank rate, offers a more hopeful future for the British iron and steel industries. There has been no perceptible increase in buying in the pig-iron markets, which have been quiet for many weeks, but there is a decidedly more hopeful feeling abroad.

Pig-Iron.

MIDDLESBROUGH.—In view of the long-prevailing hand-to-mouth buying in this district, it is gratifying to note that consumers are now more willing to discuss forward contracts. There has been a steady reduction in stocks of Cleveland and basic iron at the makers' works, and an increase of production is not improbable. The market hung fire to a certain extent, pending the announcement of the recommendations of the Import Duties Advisory Committee, but business is now once more on the move. Prices are unchanged, as follow:—No. 1 Cleveland foundry iron, 61s.; No. 3 Cleveland G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; No. 4 forge, 57s., f.o.t. or f.o.b.

The tone of the East Coast hematite market has much improved, prompt offers of mixed numbers at less than 63s. 6d. per ton being mostly withdrawn. A higher forward quotation is now being made. No. 1 quality is quoted at 6d. per ton more. Deliveries to consumers have been rather disappointing of late, while only a few odd cargoes have been shipped abroad. The demand for West Coast hematite has not improved, although the restarting of the Workington steelworks means an increased local consumption.

LANCASHIRE.—Forward buying has been more active, and the total tonnage booked shows a welcome increase. Deliveries to consumers remain at a steady level. The textile machinists and light-castings foundries in this area are slightly better situated. Prices are steady on the basis of 67s. per ton for Staffordshire, Cleveland and Derbyshire brands of No. 3 iron, 65s. 6d. for Northants No. 3, 62s. for Derbyshire forge, from 86s. 6d. to 87s. for Scottish foundry, and about 81s. per ton for West Coast hematite iron, including delivery in the Manchester district.

MIDLANDS.—There has been a certain amount of forward covering by consumers during the past week, but the total turnover has not been sufficient to affect prices, which remain at the minimum levels, as follow:—Northants No. 3, 62s. 6d.; North Staffordshire, Derbyshire and Lincolnshire No. 3, 66s. per ton, delivered Black Country stations or sidings.

SCOTLAND.—Few orders for pig-iron are being taken, as most of the foundries are working only two or three days a week. It is impossible to foresee any improvement in the situation for several months. No. 3 Scottish foundry iron remains at 69s. 6d. per ton f.o.t. furnaces, with a minimum of 2s. 6d. extra for No. 1. Middlesbrough iron meets with a poor demand at 58s. 6d. per ton f.o.t. Grangemouth for No. 3. An odd parcel of Continental basic iron was on offer last week at 57s. f.o.t. steelworks, but no foundry iron is on the market.

Coke.

Little new buying has been witnessed in the foundry-coke market during the past week, most consumers being already well covered for many weeks ahead. There has been no change in prices. Best Durham coke is offered at 37s. 6d. to 40s. per ton delivered in the Birmingham area, with cheaper grades at about 35s. For Welsh coke quotations are from 30s. to 45s., according to analysis.

Steel.

Business in finished steel is very quiet at the moment, although the outlook is much more encouraging now that an increased duty has been placed on foreign material. A meeting of the Steel Association was held in London last week, but it was decided to make no change in prices. There is only a slack demand for tinplates and galvanised steel sheets. No transactions in Continental semis have been reported during the past few days. The gap between the prices of English and foreign semis has practically been bridged by the new 33⅓ per cent. duty, and the British works should now have more success in the home market. Few orders are being booked at the moment owing to the large stocks of material held by consumers.

Scrap.

Business is dull in the Cleveland scrap-iron market, and prices are mostly weak. Ordinary heavy cast-iron is lower at 38s. per ton and machinery quality at 40s., while light castings are plentiful at 35s. per ton. Similar conditions prevail in the Midlands, where most of the iron-foundries are short of work. For machinery metal, broken into handy sizes, 47s. 6d. to 50s. delivered is the general price; 42s. 6d. to 45s. is quoted for good heavy metal and 37s. 6d. to 40s. delivered for clean light cast iron. The South Wales market is also very weak, owing to the lack of any demand from consumers, many of whom have sufficient stocks to cover their meagre needs. Good heavy cast iron meets with a quiet trade at 45s. per ton, but machinery scrap in cupola sizes is very slow at 47s. 6d. per ton. A scarcity of new business is also the weakening feature of the Scottish market.

Metals.

Copper.—Following a slight recovery last Thursday, the standard market has been steady, if not over-confident. The copper situation in the United States is very disturbing. Those consumers who are still working are covered far ahead, in some cases until the end of the year, with the consequence that little new business is being done. Copper Exporters, Inc., were compelled to reduce the level at which customs metal may be sold to 6 cents per lb. c.i.f. Europe, in order to dispose of the output of the customs refineries, but this figure is already being underquoted from outside sources. It is a matter of conjecture how long the producers' combine will be able to stand the present strain. Mine after mine is being closed down, and the number of unemployed in the industry increases rapidly, but the stocks of unsold copper seem inexhaustible. Nothing short of a general revival in the consuming industries will redeem the situation.

Closing quotations :—

Cash.—Thursday, £30 5s. to £30 7s. 6d.; Friday, £30 to £30 2s. 6d.; Monday, £30 11s. 3d. to £30 13s. 9d.; Tuesday, £30 8s. 9d. to £30 11s. 3d.; Wednesday, £30 5s. to £30 7s. 6d.

Three Months.—Thursday, £30 12s. 6d. to £30 15s.; Friday, £30 7s. 6d. to £30 10s.; Monday, £30 17s. 6d. to £31; Tuesday, £30 12s. 6d. to £30 15s.; Wednesday, £30 7s. 6d. to £30 10s.

Tin.—The market has shown a much stronger appearance. After last Thursday's rise there was a certain amount of profit-taking, but the news of further output-curtailment proposals soon nullified its effects. The International Tin Committee recommends a further cut in production to the extent of 20,000 tons, to take effect from June 1. This would bring the total output down to about 80,000 tons per year, as compared with an estimated world consumption during 1931 of about 137,000 tons. The matter has to be considered by the Governments concerned.

Official closing prices :—

Cash.—Thursday, £115 to £115 2s. 6d.; Friday, £112 to £112 5s.; Monday, £117 5s. to £117 10s.; Tuesday, £116 5s. to £116 10s.; Wednesday, £114 10s. to £114 15s.

Three Months.—Thursday, £117 5s. to £117 7s. 6d.; Friday, £114 to £114 5s.; Monday, £119 10s. to £119 15s.; Tuesday, £118 5s. to £118 10s.; Wednesday, £116 12s. 6d. to £116 15s.

Spelter.—An improved demand from the galvanising industry, coupled with an absence of arrivals of Continental metal, have considerably strengthened this market. The latter factor is explained by strong buying in Germany, where a duty will probably be imposed on the import of spelter, owing to the unfortunate position of the German zinc mines.

Daily fluctuations :—

Ordinary.—Thursday, £12 8s. 9d.; Friday, £12 17s. 6d.; Monday, £12 11s. 3d.; Tuesday, £12 11s. 3d.; Wednesday, £12 10s.

Lead.—English consumers have been showing more interest, owing to the exhaustion of stocks bought before the inauguration of the tariff, but buying is still of a small and miscellaneous character. Imports of foreign lead are stated to be shrinking, and premiums are being obtained for Empire brands, producers of which are acting in close co-operation. A further rise in the price of the latter grades is not improbable if consumption in England shows the improvement hoped.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £11 10s.; Friday, £11 17s. 6d.; Monday, £11 16s. 3d.; Tuesday, £11 15s.; Wednesday, £11 12s. 6d.

England *v.* Scotland.

Our photograph (kindly furnished by Mr. H. Winterton, of Glasgow) was taken at Blackpool on the occasion of the recent meeting of the Council of the Institute of British Foundrymen,

and shows the finalists in England *versus* Scotland foundry foursomes. England, represented by Mr. W. B. Lake, J.P., and Mr. G. C. Castle, are shown smiling after paying out the usual dollars to Mr. J. Cameron, J.P., and Mr. J. M. Primrose, the victors.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

The Fullwood Foundry.

To the Editor of The Foundry Trade Journal.

Sir,—In an article published in your paper this week describing "A Modern Ingot Mould Foundry," the author, in commenting upon a battery of six mould drying stoves, states that "the efficiency of the stoves can be gauged by the fact that the largest moulds can be dried overnight." I fail to see that this fact is any gauge of the efficiency, as, obviously, given sufficient fuel and the necessary furnaces in which to consume it, anything can be dried in one night. Surely the measure of efficiency is the quantity of fuel burnt per lb. of water evaporated.—Yours, etc.,

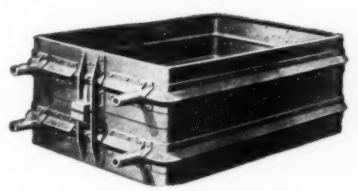
Norman G. Calder.

Thomas E. Gray & Company, Limited,
119, High Holborn, London, W.C.1.
April 25, 1932.

[We candidly admit that the phrase used by us is definitely weak, yet Mr. Calder's definition of efficiency is not quite satisfactory, as the "time" element is of importance also. One could also envisage a drying stove quite efficient, thermally, yet it would burn the moulds because of its action being too rapid. Thus the quantity of fuel used for the evaporation of a standard amount of water cannot be a decisive factor, for if one placed a bathful of water in a stove and used no fuel at all it would evaporate, whilst the same quantity placed in a Siemens-Martin open-hearth furnace would evaporate so quickly that it would be of an explosive character, yet thermally efficient.—Editor.]

Sterling

SOLID RIBBED ROLLED STEEL
MOULDING BOXES



are recognised as standard box equipment by the leading foundries and engineering establishments in this country and overseas.

Because they speed up production, save unnecessary labour, produce accurate castings and make for all-round efficiency in the foundry.

STERLING BOXES WILL SAVE THEIR COST IN A FEW MONTHS.

WRITE FOR CATALOGUE No. 37.

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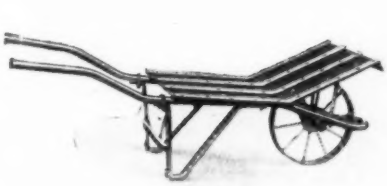
SAND, COKE, and PIG-IRON

are sturdily built to withstand the heavy duties and harsh treatment of the severest foundry service.



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WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	30	5	0
Three months	30	7	6
Electrolytic	34	10	0
Tough	33	5	0
Best selected	33	15	0
Sheets	63	0	0
India	45	0	0
Wire bars	37	0	0
Do., May	36	10	0
Do., June	36	0	0
Ingot bars	37	0	0
H.C. wire rods	39	10	0
Off. av. cash, Mar.	33	1	9 1/16
Do., 3 mths., Mar.	33	6	2 1/2
Do., Sttlmnt., Mar.	33	1	10 1/2
Do., Electro, Mar.	37	5	1 1/2
Do., B.S., Mar.	36	10	3 1/2
Do., wire bars, Mar.	37	14	6 1/2
Solid drawn tubes			9 1/2d.
Brazed tubes			9 1/2d.
Wire			6 1/2d.

BRASS.

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	7 1/4d.
Rods, extd. or rlld.	4 1/2d.
Sheets to 10 w.g.	7 1/2d.
Wire	7 1/2d.
Rolled metal	7d.
Yellow metal rods	4 1/2d.
Do. 4 × 4 Squares	5 1/2d.
Do. 4 × 3 Sheets	5 1/2d.

TIN.

	£	s.	d.
Standard cash	114	10	0
Three months	116	12	6
English	115	15	0
Bars	119	10	0
Straits	120	2	6
Australian	117	15	0
Eastern	120	10	0
Banca (nom.)	128	5	0
Off. av. cash, Mar.	129	18	2 1/2
Do., 3 mths., Mar.	131	12	6 1/2
Do., Sttlmt., Mar.	129	17	10 1/2

SPELTER.

	£	s.	d.
Ordinary	12	10	0
Remelted	11	10	0
Hard	10	10	0
Electro 99.9	15	0	0
English	13	10	0
India	12	0	0
Zinc dust	22	0	0
Zinc ashes	2	5	0
Off. aver., Mar.	12	16	4 1/16
Aver. spot, Mar.	12	12	3 1/2

LEAD.

	£	s.	d.
Soft foreign ppt.	11	12	6
English	13	10	0
Off. average, Mar.	12	9	9 1/2
Average spot, Mar.	12	6	10 1/2

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	23	0	0
Do., V.M. ex-whf.	20	10	0
Rods	27	10	0
Boiler plates			—
Battery plates			—

ANTIMONY.

	£	s.	d.	£	s.	d.
English	35	0	0 to 42	10	0	
Chinese				24	10	0
Crude				16	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	16	10	0

FERRO-ALLOYS AND STEEL NG METALS.

Ferro-silicon—	
25%	£7 2 6
45/50%	£13 0 0
75%	£17 15 0
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free, of Mo.	6/3 per lb.
Ferro-titanium—	
23/25% carbon-free	10d. lb.
Ferro-phosphorus, 20/25%	£20 12 6
Ferro-tungsten—	
80/85%	2/- lb.
Tungsten metal powder—	
98/99%	2/3½ lb.
Ferro-chrome—	
2/4% car.	£28 17 6
4/6% car.	£25 12 6
6/8% car.	£24 0 0
8/10% car.	£23 15 0
Ferro-chrome—	
Max. 2% car.	£37 15 0
Max. 1% car.	£48 0 0
Max. 0.70% car.	£52 0 0
70% carbon-free	1/1 lb.
Nickel—80/99.5%	£220 to £225
"F" nickel shot	£212 10 0
Ferro-cobalt	8/6 lb.
Aluminium 98/99%	£95 0 0
Metallic chromium—	
96/98%	3/- lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export (nom.)	£9 0 0
Metallic manganese—	
94/96% carbon-free	1/3 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 1/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel	2	2	0 to	2	3	6
Bundled steel and shrngs.	1	17	0 to	1	18	0
Mixed iron and steel	1	17	0 to	1	19	0
Heavy cast iron				2	5	0
Good machinery for foundries				2	7	6
Cleveland—						
Heavy steel				1	15	0
Steel turnings				1	12	6
Cast-iron borings				1	6	0
Heavy forge				2	15	0
W.I. piling scrap				2	7	6
Cast-iron scrap	1	18	0 to	2	0	0
Midlands—						
Light cast-iron scrap				1	17	6
Heavy wrought iron				2	12	6
Steel turnings, f.o.r.				1	1	6
Scotland—						
Heavy steel				1	17	6
Ordinary cast iron				2	5	0
Engineers' turnings				1	10	0
Cast-iron borings				1	11	6
Wrought-iron piling				2	2	6
Heavy machinery				2	11	6

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	25	0	0
Brass	18	0	0
Lead (less usual draft)	10	0	0
Tea lead	7	0	0
Zinc	6	0	0
New aluminium cuttings	72	0	0
Braziery copper	22	0	0
Gunmetal	21	0	0
Hollow pewter	70	0	0
Shaped black pewter	50	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	64/-
Hematite M/Nos.	63/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	72/6
„ d/d Birm.	84/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs common*	—
„ No. 4 forge*	61/-
„ No. 3 fdry.*	66/-
Shrops basic	—
„ Cold blast, ord.	—
„ „ roll iron	—
Northants forge*	57/6
„ fdry. No. 3*	62/6
„ fdry. No. 1*	65/6
Derbyshire forge*	61/-
„ fdry. No. 3*	66/-
„ fdry. No. 1*	69/-
„ basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	72/-
„ No. 3	69/6
Hem. M/Nos. d/d	68/6
Sheffield (d/d district)—	
Derby forge	58/6
„ fdry. No. 3	63/6
Lincs forge	—
„ fdry. No. 3	63/6
E.C. hematite	75/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
„ fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	86/6 to 87/-
Clyde, No. 3	86/6 to 87/-
Monkland, No. 3	86/6 to 87/-
Summerlee, No. 3	86/6 to 87/-
Eglinton, No. 3	86/6 to 87/-
Gartsherrie, No. 3	86/6 to 87/-
Shotts, No. 3	86/6 to 87/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£	s.	d.	£	s.	d.
Iron—						
Bars (cr.)				9	15	0
Nut and bolt iron	8	5	0 to	8	7	6
Hoops	10	10	0 to	12	0	0
Marked bars (Staffs) f.o.t.				12	0	0
Gas strip	10	10	0 to	12	0	0
Bolts and nuts, ¾ in. × 4 in.				12	0	0
Steel—						
Plates, ship, etc.	8	15	0 to	8	17	6
Boiler plts.	8	10	0 to	9	5	0
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ¾ in. (Untested)	6	12	6 & up.			
Flats—8 in. wide and over				8	12	6
„ under 8 in. and over 5 in.				8	17	6
Rails, heavy	8	5	0 to	8	10	0
Fishplates				12	0	0
Hoops (Staffs)				9	10	0
Black sheets, 24g.	8	0	0 to	8	10	0
Galv. cor. shts.	9	10	0 to	10	0	0
Galv. flat shts.	10	0	0 to	11	0	0
Galv. fencing wire, 8g. plain				12	7	6
Billets, soft	5	7	6 to	5	12	6
Billets, hard				6	12	6
Sheet bars	4	15	0 to	5	7	6
Tin bars				4	15	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	10½d.
Sheet to 10 w.g.	11½d.
Wire	11½d.
Rods	11 d.
Tubes	16½d.
Castings	12½d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	15.59
No. 2 foundry, Valley	15.00
No. 2 foundry, Birm.	11.00
Basic	16.39
Bessemer	17.39
Malleable	17.39
Grey forge	16.89
Ferro-mang. 80%, seaboard	75.00
O.-h. rails, h'y, at mill	43.00
Billets	27.00
Sheet bars	26.00
Wire rods	37.00
	Cents.
Iron bars, Phila.	2.11
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.50
Skelp, sheared steel	1.50
Steel hoops	1.65
Sheets, black, No. 24	2.20
Sheets, galv., No. 24	2.85
Wire nails	1.95
Plain wire	2.20
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	22/6 to 25/-
„ furnace	17/- to 18/-
Durham and Northumberland—	
„ foundry	14/6 to 15/-
„ furnace	13/- to 13/6
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes 20×14 per box	15/3 to 15/6
„ 28×20 „	30/6 to 31/-
„ 20×10 „	—
„ 18¾×14 „	—
C.W. 20×14 „	14/-
„ 28×20 „	—
„ 20×10 „	—
„ 18¾×14 „	—

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 0 0
Bars, hammered, basis	£16 10 0 to £17 0 0
Bars and nail-rods, rolled, basis	£15 17 6 to £16 5 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£18 0 0 to £23 0 0
Bars and rods dead soft, st'l	£10 0 0 to £12 0 0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Apr. 21 ..	30	5	0	inc.	13/9
„ 22 ..	30	0	0	dec.	5/–
„ 25 ..	30	11	3	inc.	11/3
„ 26 ..	30	8	9	dec.	2/6
„ 27 ..	30	5	0	„	3/9

Electrolytic Copper.

		£	s.	d.		
Apr. 21 ..	34	10	0	inc.	10/–
„ 22 ..	34	10	0	No change	
„ 25 ..	34	10	0	„	„
„ 26 ..	35	0	0	inc.	10/–
„ 27 ..	34	10	0	dec.	10/–

Standard Tin (cash).

		£	s.	d.		
Apr. 21 ..	115	0	0	inc.	132/6
„ 22 ..	112	0	0	dec.	60/–
„ 25 ..	117	5	0	inc.	105/–
„ 26 ..	116	5	0	dec.	20/–
„ 27 ..	114	10	0	„	35/–

Tin (English ingots).

		£	s.	d.		
Apr. 21 ..	116	5	0	inc.	125/–
„ 22 ..	113	5	0	dec.	60/–
„ 25 ..	118	10	0	inc.	105/–
„ 26 ..	117	10	0	dec.	20/–
„ 27 ..	115	15	0	„	35/–

Spelter (ordinary).

		£	s.	d.		
Apr. 21 ..	12	8	9	inc.	1/3
„ 22 ..	12	17	6	„	8/9
„ 25 ..	12	11	3	dec.	6/3
„ 26 ..	12	11	3	No change	
„ 27 ..	12	10	0	dec.	1/3

Spelter (Electro, 99.9 per cent.).

		£	s.	d.		
Apr. 21 ..	15	2	6	inc.	5/–
„ 22 ..	15	2	6	„	7/6
„ 25 ..	15	0	0	dec.	2/6
„ 26 ..	15	0	0	No change	
„ 27 ..	15	0	0	„	„

Zinc Sheets (English).

		£	s.	d.		
Apr. 21 ..	23	0	0	No change	
„ 22 ..	23	0	0	„	„
„ 25 ..	23	0	0	„	„
„ 26 ..	23	0	0	„	„
„ 27 ..	23	0	0	„	„

Lead (English).

		£	s.	d.		
Apr. 21 ..	13	10	0	No change	
„ 22 ..	13	15	0	inc.	5/–
„ 25 ..	13	15	0	No change	
„ 26 ..	13	15	0	„	„
„ 27 ..	13	10	0	dec.	5/–

AVERAGE MONTHLY PRICES OF FURNACE COKE D/D MIDDLESBROUGH.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1901	0 17 6	0 14 0	0 13 0	0 14 0	0 14 6	0 15 0	0 15 3	0 15 3	0 15 9	0 16 6	0 16 9	0 16 9	0 16 4½
1902	0 16 9	0 15 0	0 15 0	0 15 0	0 15 0	0 15 3	0 15 3	0 15 3	0 15 6	0 16 0	0 16 6	0 16 6	0 15 5
1903	0 15 9	0 16 0	0 16 3	0 16 9	0 16 6	0 16 3	0 16 0	0 15 9	0 15 6	0 15 0	0 14 6	0 14 0	0 15 8½
1904	0 13 9	0 13 9	0 13 3	0 14 3	0 14 6	0 14 3	0 14 3	0 14 3	0 14 3	0 14 0	0 14 0	0 14 6	0 14 1½
1905	0 14 9	0 15 3	0 15 3	0 15 3	0 15 6	0 15 6	0 15 6	0 15 6	0 15 6	0 15 6	0 15 9	0 17 0	0 15 5½
1906	0 17 6	0 17 6	0 17 0	0 17 0	0 17 0	0 16 6	0 17 0	0 17 0	0 18 3	0 18 6	0 19 0	1 0 0	0 17 8½
1907	1 4 6	1 5 0	1 5 0	1 0 6	1 2 0	1 1 0	1 1 0	1 1 0	1 2 0	1 1 6	1 0 0	0 17 0	1 1 8½
1908	0 16 0	0 16 0	0 15 6	0 16 0	0 16 3	0 16 0	0 15 6	0 15 6	0 15 6	0 15 3	0 16 0	0 16 0	0 15 9½
1909	0 16 0	0 15 3	0 15 0	0 14 9	0 15 6	0 15 9	0 15 6	0 15 6	0 16 6	0 17 0	0 17 6	0 17 0	0 15 11½
1910	0 18 4½	0 18 6½	0 18 0	0 18 0	0 17 10½	0 17 0	0 16 1½	0 15 9½	0 15 11	0 16 0	0 15 9½	0 15 8	0 16 11
1911	0 16 0	0 15 10½	0 15 6	0 15 3	0 14 9	0 14 6	0 14 6	0 14 6	0 14 6	0 14 11½	0 15 0½	0 16 3½	0 15 1½
1912	0 17 3	0 17 3	0 18 6	0 18 10	0 19 0	0 19 4½	0 19 10½	1 0 9½	1 2 9	1 4 1½	1 5 8½	1 8 6	1 1 0
1913	1 5 9	1 4 11	1 5 0	1 5 0	1 4 9½	1 0 4½	0 19 5½	0 18 3	0 18 0	0 18 2½	0 18 6	0 18 6	1 1 4½
1914	0 18 2	0 17 1	0 17 0	0 17 0	0 17 4	0 17 6	0 17 6	0 18 5	0 18 4	0 17 9	0 17 6	0 18 5	0 17 8
1915	0 17 10½	0 17 9	1 0 4½	1 7 7½	1 9 4½	1 10 7½	1 9 7	1 7 3	1 5 4	1 4 9	1 9 6	1 13 0	1 6 1
1916	1 10 9	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6½
1917	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 14 3	1 15 6	1 11 2½
1918	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6
1919	1 15 6	1 15 6	1 15 6	1 15 6	2 1 6	2 1 6	2 3 9	2 10 6	2 10 6	2 10 6	2 10 6	2 10 6	2 3 5
1920	2 12 3	2 14 0	2 19 0	2 19 0	3 3 8	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 2 6
1921	3 1 0½	2 19 0	2 16 0	2 7 0	2 6 6	2 6 6	2 0 6	2 0 0	1 13 11	1 12 9	1 10 4½	1 8 3	2 3 6½
1922	1 7 0½	1 8 1½	1 9 7½	1 8 4½	1 7 11½	1 7 3	1 6 9½	1 6 10½	1 7 0½	1 10 2½	1 10 0	1 9 11½	1 8 3½
1923	1 11 3	1 14 6	2 0 1½	2 2 8½	2 4 4½	2 2 10½	2 1 0½	2 1 6	2 0 9½	1 18 9	1 18 8½	1 18 3	1 19 7½
1924	1 16 6½	1 14 9	1 11 11½	1 10 0½	1 8 1½	1 7 8½	1 7 3	1 6 3	1 6 0	1 5 0	1 5 0	1 5 0	1 9 5½
1925	1 4 10½	1 4 1½	1 13 3	1 2 4½	1 2 2½	1 1 5½	1 1 3½	1 4 9	0 18 10½	0 18 4½	0 19 6½	1 1 4½	1 2 8½ (5 months)
1926	1 2 1½	1 0 9	0 19 2½	0 18 6½	Strike	Strike	Strike	Strike	Strike	Strike	Strike	1 5 0	1 1 1½
1927	1 5 6	1 4 9½	1 6 1½	1 3 9	1 2 6	1 0 8½	0 19 4½	0 19 0	0 18 7½	0 18 0	0 17 10½	0 17 6	1 1 1½
1928	0 17 6	0 17 10½	0 18 0½	0 17 11½	0 17 8½	0 17 6½	0 17 7½	0 17 6½	0 17 6	0 17 7½	0 17 7½	0 17 6	0 17 8
1929	0 17 7½	0 18 0	0 19 0	0 19 6½	0 18 10½	0 19 10½	1 1 3½	1 1 8½	1 3 0	1 3 6	1 3 8	1 3 1½	1 0 9½
1930	1 2 6½	1 1 3	1 0 3	0 19 1½	0 17 7	0 16 10½	0 16 6	0 16 6	0 16 9	0 17 0	0 17 0	0 17 0	0 18 2½
1931	0 17 0	0 16 7½	0 16 0	0 16 0	0 15 11	0 15 5	0 15 1	0 15 0	0 15 0	0 16 9	0 17 0	0 16 8	0 16 0½
1932	0 17 0	0 16 11½	0 16 5½	—	—	—	—	—	—	—	—	—	—

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

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REGISTERED TRADE MARK

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

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ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

FOUNDRY Engineer seeks engagement, to visit chief foundries of England from Manchester, for pig-iron contracts; 9 years' experience.—Address, Box 156, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

MATHER & PLATT require a Brass-foundry Foreman, age about 35-40 years. Large weekly output in equal proportions from machine and floor. Only practical men capable of producing highest-quality work to specification need apply. Good salary offered.—Apply by letter to Employment Dept., Park Works, Manchester.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of The Foundry Trade Journal.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

IRON MOULDER desires position as Assistant Foundry Foreman; technical knowledge all branches iron and non-ferrous work; moderate salary accepted. Practical First Aid man. (170)

POSITION required as Foreman or Assistant to Manager by young Foundryman with exceptional practical experience in all classes of iron and non-ferrous foundry-work. Has held positions as foreman. Technically trained. Excellent references. (171)

EXPERIENCED MOULDER, used to all classes of Marine and General work, from few pounds to 25 tons. Held positions as foreman. Seeks position as Foreman, Assistant, or as Moulder. (172)

HEAD Foundry Foreman requires position. Extensive experience on machine tools, chemical and hydraulic plant. Loco, Diesel, Turbine and Marine work with well-known firms. Modern production methods. (173)

FOUNDRY Engineer seeks responsible position. Six years foundry manager, Hons. B.Sc. (Mech. Engineering). Drawing-office and good practical experience. Age 35. (174)

POSITION required as Foundry Foreman. Has had experience in similar capacity with well-known firms on steam engines, turbines, oil engines, iron- and steel-works plant. Iron castings up to 20 tons. Brass foundry and patternshop. Machine-moulding and sand-slinger experience. (175)

FOUNDRY Manager desires engagement. Had first-class experience in modern foundry practice, practical, technical and metallurgical. Grey-iron castings up to 45 tons. Non-ferrous 15 tons. Expert repetition knowledge. Age 44. (176)

PUBLICATION.

RYLAND'S DIRECTORY of the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades. 1932 edition. Now ready. Price 42s., bound in cloth.—Industrial Newspapers, Ltd., 49, Wellington Street, Strand, London, W.C.2.

PROPERTY.

MAGNIFICENT

11 ACRES WORKS SITE.

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145,000 Sq. Ft. of Shops.

SIDING CONNECTIONS

with L.M. & S. and L. & N.E. Rlys.

WELL-BUILT & COMMODIOUS OFFICES

Will Sell whole or in lots to suit customers or Let on favourable terms. Unique opportunity for Manufacturers.

Apply—

THOS. W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

FOR Sale, Modern London Iron Foundry with railway-siding facilities, on acre of land. Electric power and small machine-shop suitable for castings up to 3 tons in weight, capacity 20 tons per week. Overhead crane and all equipment.—Box 158, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

PATENTS AND TRADE MARKS.

PROTECT YOUR IDEAS.—Free, "Advice Handbook" on patenting inventions and registering trade marks by Registered Agent with 45 years' experience.—Kings Patent Agency, Limited, 146a, Queen Victoria Street, E.C.4.

TENDER.

METROPOLITAN WATER BOARD.

TENDERS FOR THE SUPPLY OF STORES, ETC.

THE Metropolitan Water Board invite Tenders for the supply of the undermentioned STORES and SERVICES, etc., for periods of 6 and 12 months commencing June 1, 1932 :—

Tender No.	
1	Bricks, Firebricks, Cement, etc.
8	Iron and Steel.
9	Bolts and Nuts, Screws, Files, Shovels, Steam Tubes, etc.
12	Fuel Oil, Oil (Lubricating), Kerosene, Motor Spirit, Greases, Tallow, etc.
19	Iron, Brass, Gunmetal and other Castings.
20	G.M. Stopcocks and Ferrules, Outlets and Caps for Fire Hydrants.
22	Timber.
23	Maintenance of Weighing Machines.

Tenders must be submitted on the official forms, which may be obtained on and after Friday, April 29, 1932, from the Chief Engineer, by personal application at the offices of the Board (Room 155) or upon forwarding a stamped addressed sack envelope.

Applicants should refer to the number of the Tender for which forms are required.

Tenders, enclosed in sealed envelopes, addressed to "The Clerk of the Board," and endorsed in the manner indicated in the Form of Tender, must be delivered at the Offices of the Board (Room 122) not later than 11 a.m. on Wednesday, May 18, 1932.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery Avenue, E.C.1.
April 23, 1932.

MACHINERY.

WHEEL Moulding Machines. One each 4 ft. 6 in., 5 ft. 0 in. and 6 ft. 0 in. Machines, new, to be sold at much-reduced prices.—Write for particulars, Buckley & Taylor, Limited, Oldham.

MACHINERY—*Continued.*

SAND MILL, 6 ft.; underdriven self-discharging pan: two Sand Disintegrators; 6 draw Coke-fired Core Oven; also Pneumatic and Adaptable Moulding Machines, Tilting Furnaces, Blowers and Exhaust Fans, Air Compressors, Grinding Machines and 300 Electric Motors for all systems.—Send your inquiries to S. C. Bilsby, A.M.I.C.E., A.M.I.E.E., 215, Barclay Road, Warley, near Birmingham. 'Phone: Bearwood 1103.

THOS. W. WARD, LTD.

"Roots" Acme Blower, size L.
Leimann Patent H.P. Blower, size E.
3 Geared Foundry Ladles, each 3′ 7″ x 3′ x 3′ 9½″.
3′ 2″ Cold Iron Band Saw.
STEEL BUILDING, 37′ long x 19′ x 19′ 6″ high.
STEEL BUILDING, 33′ 6″ long x 30′ 6″ x 25′ high.

ALBION WORKS, SHEFFIELD.
"Albion" Catalogue on application.

MISCELLANEOUS.

"DEY" Time Recorders (3) for 50 hands, £10 10s. each: Flat-top Oak Desks, 5 ft. x 2 ft. 9 in., 7 drawers and flaps, £7 each.—Urquhart, 58, Defoe Road, Tooting Broadway, London, S.W.

'Phone: 287 SLOUGH

LADLES—GEARED

12-Ton "Stevenson"	... ...	£48
9-Ton "MacNeil"	... ...	£42
6-Ton "Thwaites"	... ...	£34
4-Ton "Evans"	... ...	£28
2-Ton "Evans"	... ...	£19

PNEUMATIC SQUEEZERS

14″×16″ Mumford split pattern 2 @ £35
16″ × 16″ "Coventry" jolt squeezers ... ... 2 @ £35
14″×16″ Tabor split pattern ... 1 @ £35

ABOVE ARE AS NEW.

BUY FROM ME AND SAVE MONEY!

Alex. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH

NICKEL
CHROMIUM
VANADIUM
TITANIUM, ETC.

Bradley's

REFINED
ALLOY PIG IRONS

WE have available a new range of compositions containing varying proportions of Nickel, Chromium, Vanadium, Titanium, etc., specially suitable for high duty castings required to withstand high temperature and corrosion.
THE USE OF ALLOY ADDITIONS ENSURES UNIFORM STRUCTURE AND GREATER RESISTANCE TO WEAR.

BRADLEY & FOSTER LIMITED
DARLASTON, STAFFS

Telephone: Darlaston 16 (P.B. Ex.) Telegrams: "Bradley's, Darlaston."